Expressing Oregon Environmental Benchmarks In Ecological Terms
Recommendations to the Oregon Progress Board

Progress Report 2 from the Science Working Group
and
Fish Benchmarks Summit Participants

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Summary

This is a progress report of work done and work still underway by a team of scientists and agency specialists to explain and refine the environmental Benchmarks used by the Oregon Progress Board. It documents changes made and changes proposed to improve the Benchmarks and it discusses work that remains for further improvements. The Environmental Benchmark project is a work in progress and this report documents progress as of the cover date.

A multidisciplinary team of scientists (Appendix 1) examined 10 of the 16 environmental Benchmarks that are tracked by the Oregon Progress Board. The intent of the environmental Benchmarks is to provide a fair assessment of the status and trends of Oregon's environmental health. The scientists were asked to clarify Benchmark definitions if necessary, explain the status of data for the Benchmarks, and define ecologically possible conditions for each of those Benchmarks for which such conditions could be identified.

For each benchmark, the scientists initially answered a set of questions designed to highlight the strengths and weakness of the existing measure. Answers to these questions constitute the majority of this report. Subsequent to that initial assessment, a "fish summit" was held on July 3, 2002, to consider revamping Benchmarks (BM) 85-87, following findings of the initial meeting that those Benchmarks needed work beyond the capability of the initial science team. Those recommendations are now incorporated in this progress report. Most recently, Hal Salwasser drafted additional findings in response to a request from Oregon State University President Paul Risser that the science team begin examining the congruence of Oregon's Benchmarks with national and international

environmental indicators.

Principle Findings:

1. All of Oregon's environmental Benchmark subjects focus on the right kinds of factors to describe and track Oregon's environmental health.
2. Other Benchmarks/Indicators that could be added to better inform Oregonians of progress on environmental aspects of sustainability include:
    a. Percentage of stream and river courses meeting riparian management standards
    b. Soil quality and erosion rates
    c. Groundwater quality
    d. Nutrient conditions, e.g., nitrogen in waters

    These could be considered as developmental Benchmarks for future work.
3. If the Progress Board adopts all recommended changes, 7 of the 16 environmental Benchmarks could indicate Oregon's environmental health: wetlands, water quality, forestlands, freshwater species, marine species, terrestrial species, and invasive species.
4. Nine of the 16 environmental Benchmarks would still indicate administrative performance rather than environmental health: air quality, CO2 emissions, instream water rights, agricultural lands, timber harvest, solid waste, hazardous waste, at-risk species in protected areas, and state parks.
5. Ecological reference conditions can be and were described for nine Benchmarks.
6. Ecologically achievable conditions can be and were described for those nine Benchmarks.
7. Virtually all of the Benchmarks can and should be stratified by ecoregion or basin.
8. The conditions indicated by roughly half of the Benchmarks are probably interrelated, e.g., streams, wetlands, forestlands, at-risk species.
9. Ecologically possible conditions described for several Benchmarks could be considered upper limits possible to ensure sustainable ecological processes and functions given existing human transformations of ecosystems. The assembled scientists did not describe the lower bounds of sustainable ecological conditions, processes and functions, as those are policy choices to be made through administrative or political means.
10. There is weak alignment of the Oregon environmental Benchmarks with indicators proposed for use at national level. Some overlap exists and some uniqueness occurs in the various systems.

Policy-related issues warranting further discussion:

1. Nature and scale of decisions likely to be informed (influenced?) by information on the Benchmarks and the need to link local and basin-scale indicators currently being developed to monitor the effectiveness of agency plans and programs, e.g., the Oregon Plan for Salmon and Watersheds, state forest plans, and the federal Northwest Forest Plan, to the Benchmarks.
2. Frequency with which measurements and analysis for each Benchmark are useful to decision making, given the temporal and spatial variability inherent in Oregon's ecological systems.
3. Accuracy of measurements needed for policy or program decisions at each scale.
4. Implications of the interaction or interrelatedness among some individual Benchmarks.

Specific Recommendations

1. Adopt changes recommended in this report to clarify the definition of certain Benchmarks and commission work on developmental Benchmarks to responsible state agencies.
    a. BM 77 - Develop reliable estimates of original wetland acreage in the state and tie the new Benchmark definition to it. Task to DSL.
    b. BM 78 - Accept as is in this report.
    c. BM 79 - Accept as is in this report.
    d. BM 81 - Work toward replacing existing Benchmark with acreage of forest type and structural stage by ecoregion (under study as a developmental Benchmark). Oregon Department of Forestry is doing this as part of the Forestry Program for Oregon, work currently underway.
    e. BM 82 - Accept as in this report. Assure that harvest quantity is included in benchmark description.
    f. BM 85 - Proposed for November 19, 2002 decision to change to "percent of monitored freshwater species not at risk." Task ODFW to implement. Set policy target for indicators - Progress Board.
    g. BM 86 - Proposed for November 19, 2002 decision to change to "percent of monitored marine species not at risk." Task ODFW to implement. Set policy target for indicators - Progress Board.
    h. BM 87 - Proposed for November 19, 2002 decision to change to "percent of monitored terrestrial species not at risk." Move current BM 87 to BM 88. Task ODFW and ODA to implement. Set policy target for indicators - Progress Board.
    i. BM 88 - Work toward replacing with developmental Benchmark "Percent of at-risk species meeting conservation strategy goals." Task Institute for Natural Resources and Oregon Natural Heritage Information Center to develop. There is no relevant policy target for this Benchmark as currently worded.
    j. BM 89 - accept as is in this report.
2. Link data collection and management for the Benchmarks to ongoing work in the state to coordinate agency plan and program monitoring and data management (this is underway now).
3. Explore possibilities for improving alignment of Oregon Benchmarks with national and international indicators. Task to Institute for Natural Resources as part of future revisions to State of the Oregon Environment Report.
4. The Progress Board should move toward expressing Benchmarks in a way that shows the explicit relationships that exist between many of the environment Benchmarks.

Introduction

The State of the Oregon Environment Report 2000 (SOER) included a set of environmental indicators (analogous to the Progress Board's "Benchmarks") that could be used to assess the health of Oregon's environment. Collectively these Indicators/Benchmarks were designed to provide measures of environmental health based on three dimensions: maintaining natural ecological conditions, providing ecological goods and services for humans, and adhering to environmental laws and regulations. The Oregon Progress Board has accepted most of the Indicators/Benchmarks recommended in SOER and the Governor has requested that state agencies incorporate them in program planning and budgeting.

The challenge for assessing progress on sustainability is to have measures of the Benchmarks by

which it is possible to judge attainment or progress towards the goals associated with them (many of these goals are yet to be established). These measures need to accurately represent the condition of the Benchmark in a meaningful way, and be able to be quantified and tracked with consistency over time to provide a basis for evaluation and subsequent policy and management decisions.

Oregon currently uses 90 Benchmarks to represent aspects of the state's social, economic and environmental systems (Oregon Progress Board 2001). Most of the Benchmarks relate to social systems and our society, but 16 relate to the environment, of which humans (a) are a part, (b) affect, and (c) are dependent on. The Benchmarks as a whole are intended to incorporate elements of ecological, economic, and social sustainability. The logic is that the ecological systems upon which human communities depend must sustain both the needs of those human communities and the ability of those ecosystems to persist in robust, healthy, resilient and productive conditions. There are many possible conditions for any individual Benchmark that could be ecologically sustainable, but it is necessary that the level selected as the Benchmark goal be socially and economically sustainable as well. However, Benchmark goals that are not ecologically sustainable cannot ultimately be socially sustainable. Therefore any process that establishes Benchmark goals must do so within a range of conditions that are simultaneously ecologically, socially and economically sustainable.

Paul Risser, chair of the Science Panel that produced the *State of the Oregon Environment Report 2000*, asked the Institute for Natural Resources at Oregon State University to convene a panel of scientists to identify values for each of the environmental Benchmarks that if attained would ensure with a high degree of confidence, i.e., ~ 95% confidence on the part of the scientists, that the resources associated with it would be ecologically sustainable over time. This is a report of that panel of scientists.

This report identifies ecologically possible values/conditions for certain environmental Benchmarks based on best available science, e.g., field data plus the reasoned and documented judgments of the scientists. The panel focused on the Benchmarks designed to describe the first dimension of environmental health - maintaining natural, ecological health.

Specifically, those are:

- Benchmarks 77, 78, and 79 dealing with water and wetlands;
- Benchmarks 81 and 82 dealing with forests and timber harvests; and
- Benchmarks 85, 86, 87, 88, and 89 dealing with biodiversity: fish, plant, animals, and invasive species.

Subsequent sections describe the scientist's thinking on ecologically possible values or conditions for each of the 10 environmental Benchmarks that we addressed, including assumptions about the quality and use of the resource, and the conditions under which these assumptions are applicable. In some cases we recommend that Benchmarks be modified to be more reflective of ecological as opposed to administrative conditions. The report concludes with a summary of findings. Appendix 1 provides a list of participants in this process. Appendix 2 is a brief history of the Oregon Progress Board. Appendix 3 details key definitions and assumptions used in the report.

We believe this report is a scientifically sound starting point from which the Oregon Progress Board

can set policy targets for ten of the environmental Benchmarks reviewed in this report. The other six environmental Benchmarks already have policy targets set through other means. Final environmental policy targets that incorporate the economic and social considerations necessary for sustainability should fall within the range of the ecologically possible values or conditions described in this report, or in future revisions to this report. Doing so will increase the likelihood that the outcomes will be ecologically sustainable and will therefore meet the goals and needs of Oregonians in the future.

Process for Describing Ecologically Possible or Optimal Values/Conditions

The panel of scientists included people from Oregon State University, federal and state agencies, and the private sector (see appendix 1). Panelists studied the *State of the Oregon Environment Report 2000*, the Progress Board Benchmarks and publications on national level indicators from the Heinz Center and the National Research Council. This and preliminary material on Benchmark measures was discussed by the panelists at a workshop at Oregon State University on January 22, 2002. In a collaborative process we arrived at the Benchmark measures and the conclusions and recommendations in this report. Subsequent to the January workshop, the Progress Board convened another group of experts in a "fish Benchmarks summit" that met in Salem, OR on July 3, 2002 to refine Benchmarks 85-88.

We considered the following questions in our work:

- Does the definition of the Benchmark require any further clarification?
- what is the current quantitative status of the Benchmark, and can or should that status be stratified by ecoregion, basin or watershed?
- is there a documented status of the Benchmark at some point in the past that could be used as the historical reference? If so, what is the rationale for selecting this reference status and is it a useful comparison for setting a target for now and in the future?
- What is biologically and/or physically possible for the Benchmark's ecological conditions given existing limits, e.g., dams on major rivers, farms in what used to be forested valleys, Urban Growth Boundaries, etc.? If such limits are not fixed, then how should the potential to alter those limits be incorporated in the definition of the desired condition?

There is no existing single database or reference study that can be used to establish unequivocal, definitive ecological values or conditions that will ensure sustainability, especially since these values or conditions will need to be qualified by assumptions about quality, use and prevailing environmental conditions. Thus, panelists synthesized information from many sources in combination with reasoned judgments about the applicability of data to circumstances throughout Oregon. Individual panelists took the lead in developing material for specific Benchmarks, but each member of the panel had opportunity to review this full work.

A comparison of Oregon Benchmarks, SOER recommended indicators and two sets of indicators recommended for use at the national level found quite a few similarities between categories of measures. No measures were the same across all four sets, however. See Table 2, page 46, for a detailed comparison. If directed by the Governor or Legislature, in preparation for future revision to the State of the Oregon Environment Report, an appropriate institution, e.g., Progress Board, Department of Administrative Services, or Institute for Natural Resources, should develop a means of

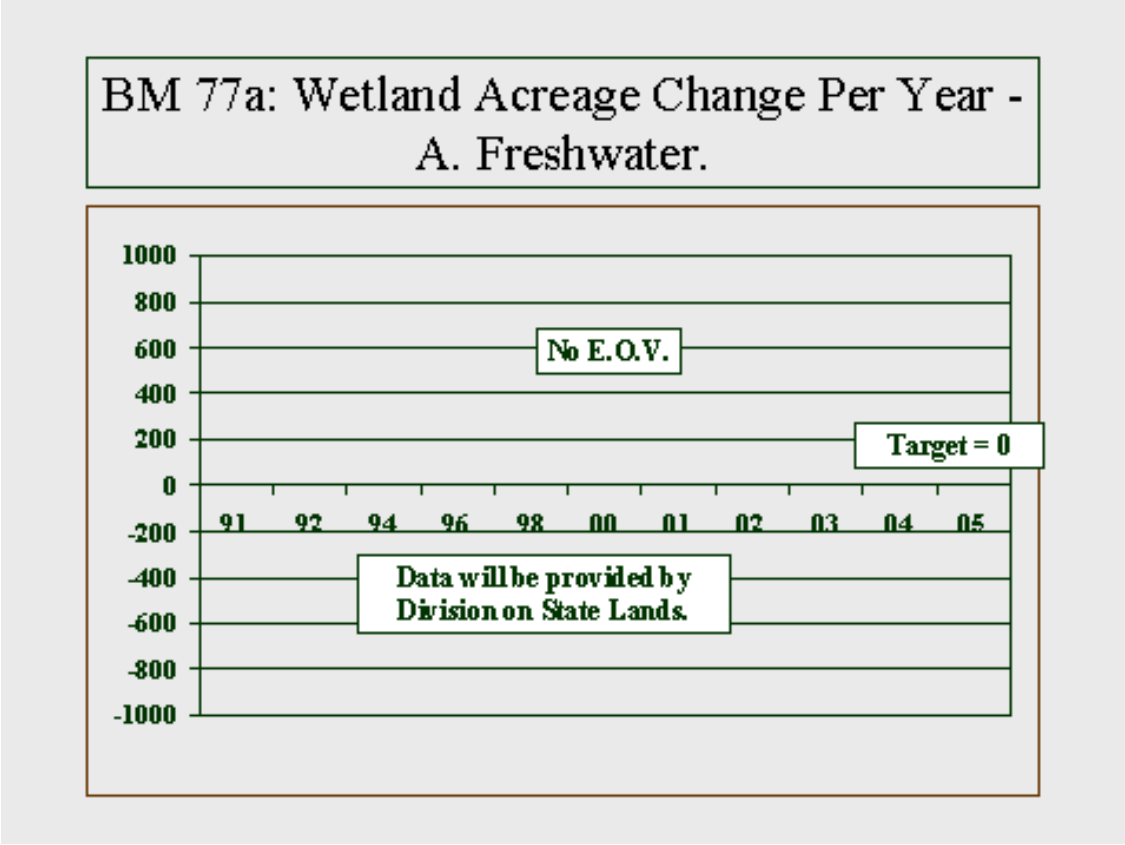
relating Oregon's environmental Benchmarks to national indicators as appropriate to best serve state needs.

Ecological Values for Individual Benchmarks

Benchmark 77: *Pre-SOER Language*: Wetland acreage as a percentage of 1985 wetland acreage
a. freshwater wetlands
b. estuarine wetlands

***Current Language*: Wetland acreage change per year**
a. Freshwater
b. Estuarine

Subject experts: Janet Morlan and Jim Good



Possible future change in Benchmark definition: Percentage of historic wetland acreage achieved.

Ecologically Possible or Optimal Value or Condition for Freshwater Wetlands: Restoration to wetland acreage and conditions that existed prior to settlement and developments following the mid 1800s where physically and economically possible. Existing physical and economic constraints limit what is possible.

Issue: *Does the definition require further clarification?*

The existing Benchmark definition recognizes the lack of readily available historical and trend data. The 1985 acreage target was not an ecological goal; it reflected perceptions of what is possible. (Referring to pre-SOER Progress Board language,)

Issue: *What is the current quantitative status of the Benchmark; can/should it be stratified?*

Data for the current Benchmark are adequate for permit-related data, but unregulated losses are not factored in. If the ecologically possible value or condition is substituted, current quantitative status is poor. Existing data could and should be stratified by both ecoregion and basin to be most meaningful.

- Data on original wetland acreage (Dahl) are a guestimate; a best estimate could likely be derived from statewide soils data (acres of hydric soils).
- No good estimate of current statewide wetland acreage exists. Best available data are from a sample of National Wetlands Inventory maps for the state from mostly 1982-85 aerial photo interpretations, with some areas from the1970s and poorer quality data. (Existing data need more analysis to fully inform this Benchmark).
- For Willamette Valley lowlands ecoregion, we an have estimates of historical wetland acreage derived from presettlement vegetation mapping and we have a good sample-based estimate of current (1994) wetland acreage for roughly the same region (266,403 acres); comparing the two gives a historical loss estimate of 57%; we have a sample-based estimate of wetland loss between 1982-1994 for that region of 6,549 acres or2.4% of 1982 wetland acreage.
- Current study will provide good data on coastal lowland freshwater wetland change from 1985-2001. No interval data are available.
- can get estimates of historical wetland acreage and loss for Klamath Basin.
- Annual gain/loss data can be obtained from removal-fill permit database. It will not include all actual changes. Those data can be stratified by basin.

Issue: *Is there documented status of the Benchmark at some point for historical reference? If so, what is the rationale for selecting this reference status and is it a useful comparison for setting a target?*

Historical reference is not immediately available for state or most ecoregions. If Statsgo (soils) database is complete statewide, we could get estimate of historical acreage of wetlands based upon acres of hydric soils. Historical (at settlement) extent of wetland acreage is the most useful reference because there is no scientific basis for selecting any other reference. In addition, the location and pattern of wetland losses as well as the functioning condition of remaining wetlands and adjacent vegetation plays a huge role in the ecological viability of the remaining wetlands. Simple acreage change information will not provide this crucial information.

The only other statewide "historical" reference is the National Wetlands Inventory (1970s to mid-1980s). Only about 1/5 of state has been digitized. A dot matrix sample has been done and partially analyzed. The NWI provides a less useful comparison for target setting primarily because (a) the NWI excludes agricultural wetlands and includes non-wetlands (like riparian areas) that cannot be teased out of the data; (b) the baseline of mid-1980s reflects a considerable but unmeasured amount of

wetland loss over the historical status.

Issue: *What is biologically and/or physically possible given existing limits? If such limits are not fixed, how should the potential to alter those limits be addressed in the description of ecologically sustainable conditions?*

It is physically possible to halt many significant causes of wetland loss and both physically and biologically possible to reverse a considerable amount of wetland loss. Indirect causes of wetland loss (e.g., from unrelated activities like groundwater withdrawal that remove water source) are the most difficult to address in terms of sustainable conditions. Wetland gains from natural factors such as an increase in beaver populations are difficult to track. Wetland gains on forestland and agricultural lands from indirect factors such as road crossings or other development are not tracked.

Issue: *What policies address this Benchmark?*

Positive policies:

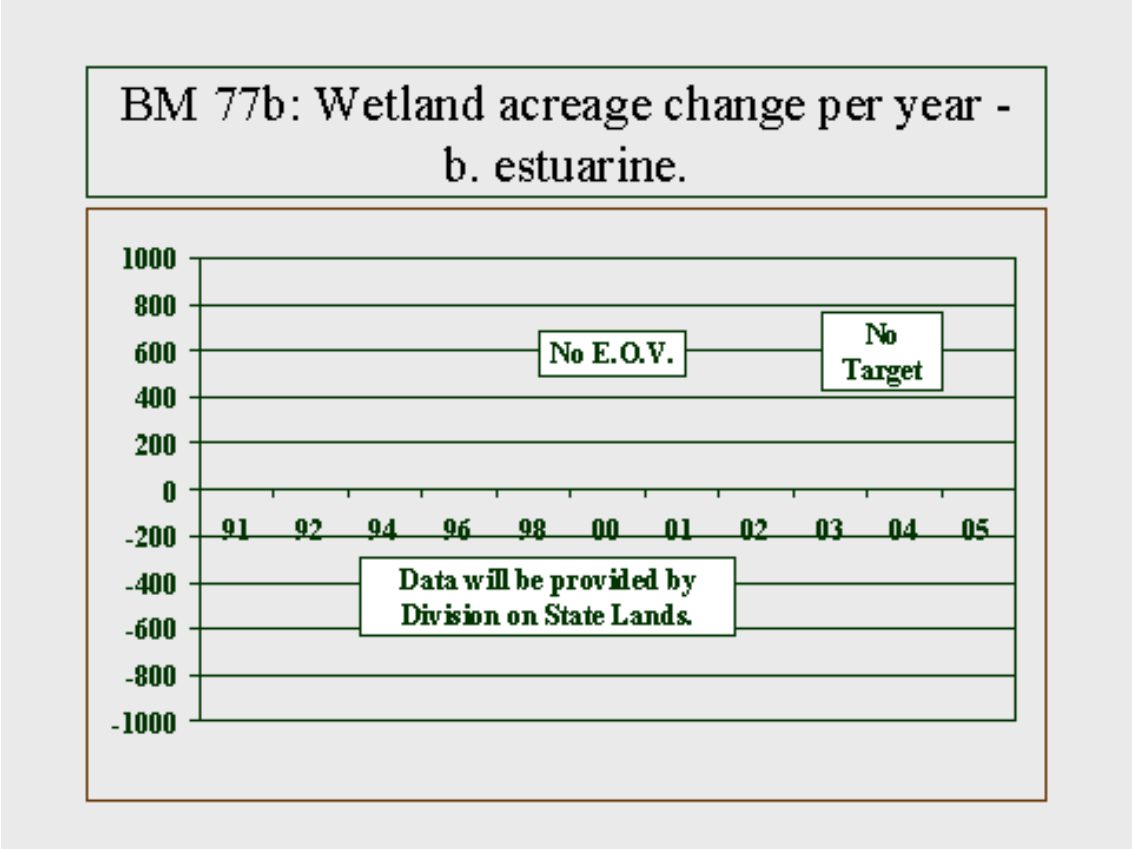
- State Removal-Fill Law and Wetlands Act (compensatory mitigation; no-net-loss goal; restoration policy goal)
- Statewide Land Use Planning Goals, primarily Goal 5 (natural resources) and local comprehensive plans. (Protection)
- Clean Water Act Section 404 (compensatory mitigation; no-net loss?)
- Farm Bill conservation programs (e.g., WRP)
- Oregon Forest Practices Act (prevent the loss of wetlands and protect the functions and values of stream associated wetlands and significant wetlands [including wetlands larger than eight acres, estuaries, bogs and important springs in eastern Oregon], and protect the functions and values of adjacent vegetation.
- Oregon Plan (some restoration)
- Willamette Restoration Initiative
- Federal funding for acquisition and restoration (refuges; Land & Water Conservation Act)

Adverse policies:

- Goals and policies directed at maintaining farmland and maximizing urban density in historic wetlands; local government ordinances that discourage voluntary restoration (conditional use requirements).

Benchmark 77b: Estuarine wetlands

Subject experts: Janet Morlan and Jim Good



Proposed Benchmark: Percentage of historic estuarine wetland achieved.

Ecologically Possible or Optimal Value or Condition for estuarine wetland acreage: Restoration to conditions of the mid 1800s (~ 74,000 acres of tidal marsh and swamp) where physically and economically possible. Physical and economic constraints limit what is possible.

Issue: *Does the definition require further clarification?*

No, with the understanding that it is not ecologically based. If it is shifted to an ecological based indicator, it will have to be redefined as the "percent of original estuarine wetland acreage."

Issue: *What is the current quantitative status of the Benchmark; can/should it be stratified?*

- Have fair estimate of acreage at settlement based upon historical maps and charts, modern topographic and wetlands maps, and soils data (~74,000 acres). This should be refined in a more systematic study than that done for SOER.
- Have good data on acres filled up through 1972 (DSL filled lands study). Needs to be updated using DSL permit data.
- Have fair estimate of current acreage (~25,000 acres)
- Do not have data but could readily do study to estimate acres historically lost due to diking and built as part of the more systematic historical study noted above.
- Current, annual gain/loss data primarily from DSL permit database supplemented by OWEB restoration database.
- Study underway by DSL will provide excellent change data for 1985 to 2001. There are no

study data for intervening years.)
- Data can be readily stratified by estuary/watershed if desired.

Issue: *Is there documented status of the Benchmark at some point for historical reference? If so, what is the rationale for selecting this reference status and is it a useful comparison for setting a target?*

Yes. Fair estimate of estuarine wetland acreage at settlement as noted above (in approx. 1870). This is the best reference as it precedes virtually all wetland loss resulting from diking, draining and filling. It is a useful comparison for setting a target based upon percentage of original estuarine wetland acreage, which is the optimal ecological value or condition.

Issue: *What is biologically and/or physically possible given existing limits? If such limits are not fixed, how should the potential to alter those limits be addressed in the description of ecologically sustainable conditions?*

- Some estuarine wetland has been filled and built (towns, airports, port facilities, etc.). Rough estimate is that statewide less than 20% of original estuarine wetland is thus affected; that estimate could be improved using filled lands inventory and permit data.
- Much estuarine wetland that has been diked for grazing and farming is biologically and physically susceptible to restoration to estuarine wetland.
- If filled/built estuarine wetlands are considered irrevocably lost, and if filled lands data indicates that a small percentage (under 20%? Ask authors for clarification) of original estuarine wetland acreage is thus affected, a judgment might be made that something less than 80% of original estuarine wetland acreage is ecologically viable and sustainable.

Issue: *What policies address this Benchmark?*

Positive policies:

- Statewide Land Use Planning Goals, primarily 16 (estuarine) and to some extent 17 (coastal shore lands) and local estuary plans adopted into local comprehensive plans. (Protection; no net loss requirements)
- State Removal-Fill Law and Wetlands Act (compensatory mitigation; restoration policy goal)
- Clean Water Act Section 404 (compensatory mitigation; federal consistency with local plan)
- Oregon Plan (some restoration of estuarine wetlands)
- Oregon Forest Practices Act (prevent the loss of estuaries from forest practices and protect the functions and values of estuaries including the functions and values of adjacent vegetation [100 to 300 foot buffer]).
- Farm Bill conservation programs (e.g., CREP)

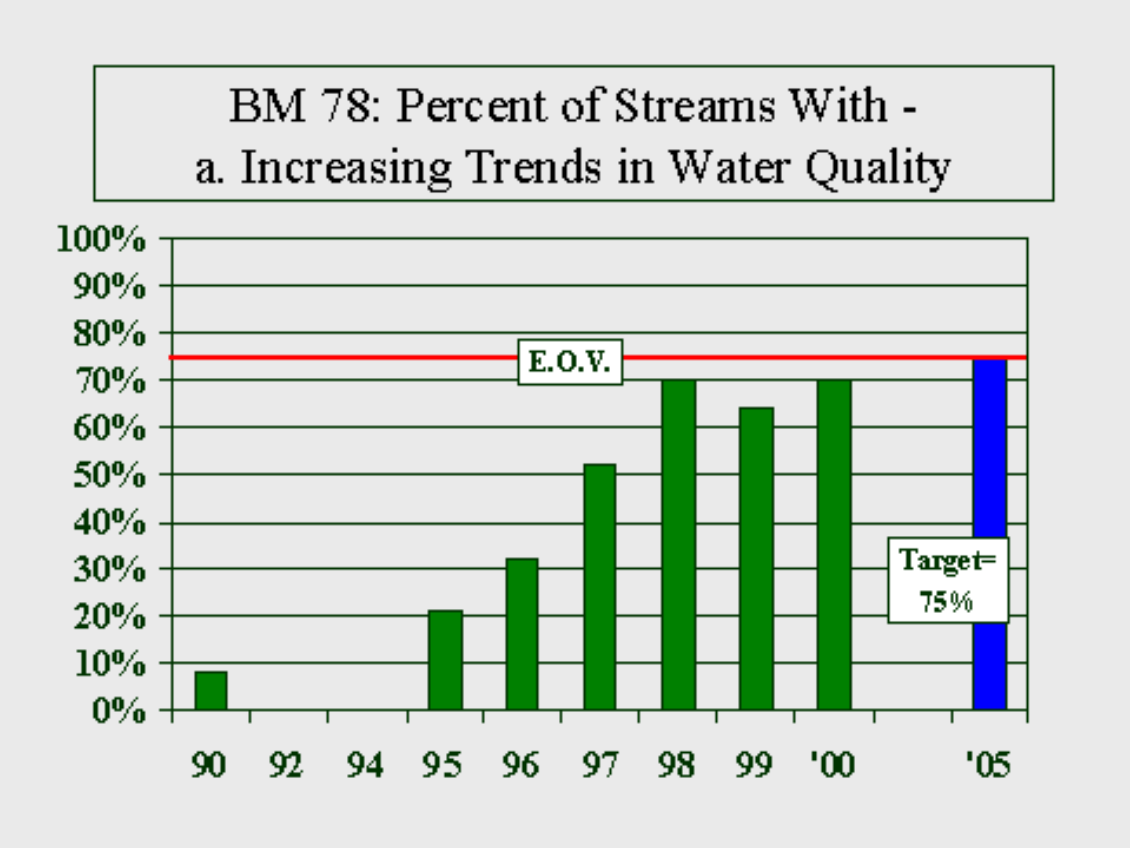
Adverse policies:

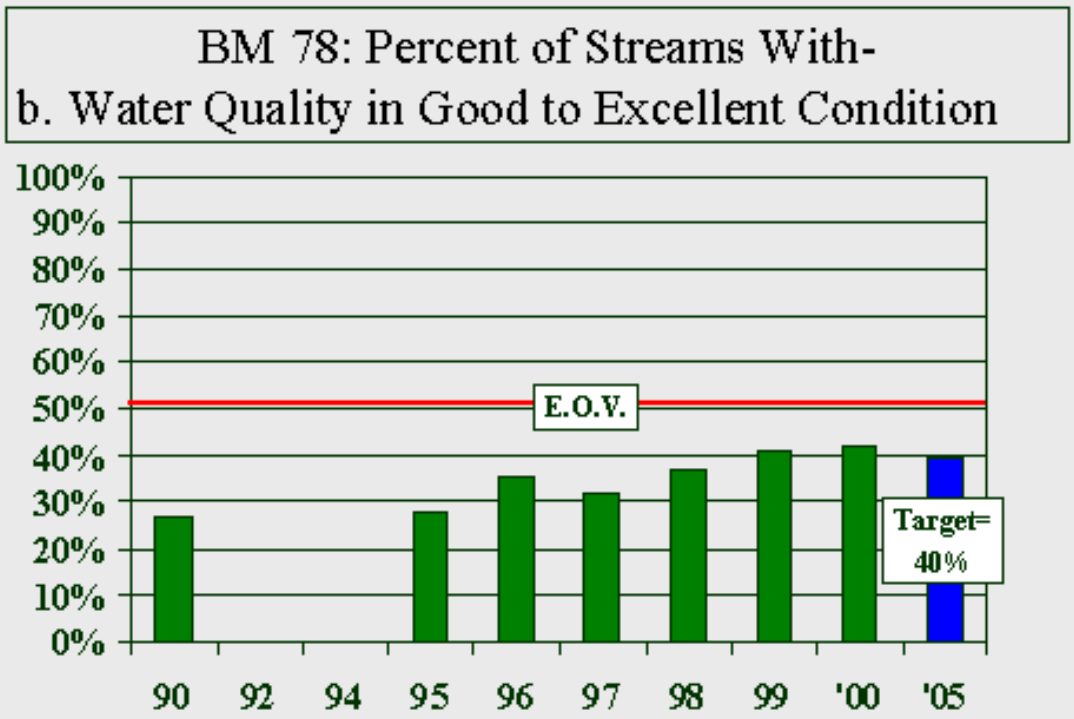
- Water Resources Development Act (dredging etc.); some local government ordinances that limit voluntary restoration (i.e., that's not mitigation)

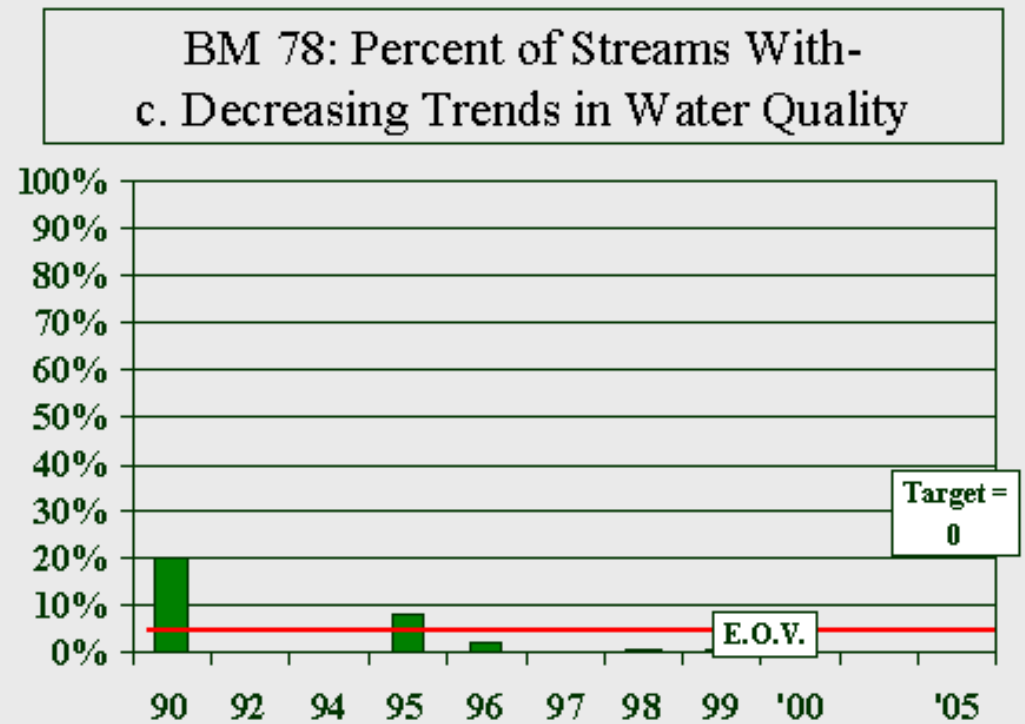
NOTE: The currently approved Benchmark 77b sets a net gain of 250 acres/year of estuarine wetlands as the target through at least 2010 (gain of 2,500 acres in total), but no final net gain target has been set. Continuing with a net gain of 250 acres/year until 2050 would yield and additional 10,000 acres of restored estuarine wetlands, which is probably feasible. Whatever gain target is ultimately selected, the 250-acres/year rate of gain is feasible for the short term, in our judgment. As the ultimate target is approached, the rate of gain can be expected to decrease.

Benchmark #78
***Current Language*: Percent of monitored stream sites with:**
a. Significantly increasing trends in water quality
b. Water quality in good to excellent condition
c. Decreasing trends in water quality

Subject expert: Rick Hafele







Ecologically optimal value for sustainability =
a. Significantly increasing trends in water quality: 75%
b. Water quality in good to excellent condition: 50%
c. Decreasing trends in water quality: 0%

Issue: *Does the definition of the Benchmark require any further clarification?*

Yes. The public and policy makers need to clearly understand the type of data behind this Benchmark and their limitations. The primary issues for clarification include:

- clearly understand the objective of the Benchmark
- Scale and monitoring design of current water quality data used for the Benchmark.

Benchmark objective:

One of the primary objectives in the development of the current Benchmark was to reflect the success or failure of water quality management programs in protecting and restoring water quality. While one of the goals would certainly be to increase the number of streams in the good to excellent category, most of the activities of the water quality management program are directed toward improving the quality of streams that are in the fair to very poor categories. For example, Total Maximum Daily Loads (TMDLs) have been developed for the Tualatin River, Bear Creek, Yamhill River, Pudding River, and the Columbia Slough. The Oregon Water Quality Index (OWQI) scores at ambient monitoring sites in these basins are poor to very poor. That doesn't mean the water quality management programs in those basins are not effective. In basins where the TMDLs are actually being implemented, such as the Tualatin, there have been remarkable improvements in water quality. Based on the trending analysis that was done for the ten-year period ending water year 97 there was an average overall statewide OWQI score increase of 4.2. In basins where TMDLs have been developed and implemented (Tualatin, Yamhill, and Bear Creek) the average increase was 19.1 and in basins where TMDLs have not been implemented the average increase was 2.5. The Tualatin River at Boones Ferry Rd increased by 46.8 over that period of time. Despite these overall improvements in water quality in the TMDL basins, all of the sites still remain in the poor to very poor category.

Scale and monitoring design:

The current Benchmark is based on the DEQ ambient river network. There are approximately 106,000 miles of streams in Oregon, of those only 52,500 miles are perennial, and of those perennial streams approximately 44,879 miles are small first to third order streams. This leaves approximately 7,600 miles of streams that are 4th order or larger. . [I do not know the basis of these data, but they should be qualified. For example, if the data are based upon USGS quad maps, we know that the data under-represent the number of stream miles and "preeniallity" by a considerable margin. Stream order is often off by at least one order, especially in western Oregon. TK Hal who wrote the qualifying statement and what do we want to do with it?]

The ambient monitoring network is comprised of sites selected primarily from these 4th order and larger streams. The sites were selected to represent all the major rivers in the state and provide statewide geographical representation. Most of the sites reflect the integrated water quality impacts from point and non-point source activities as well as the natural geological, hydrological and biological impacts for the watershed that they represent. Larger basins have multiple sites, the locations of which may be based on tributaries, land use changes, topographical changes, ecoregions, point sources and non-point sources. With an average of one site for every 53 miles of

4th order and larger streams the network at large is closer to a census, than a survey of the larger rivers. The Department of Environmental Quality has been very careful to not represent the network as a statistically valid sampling of streams across the state. The network does not represent the smaller streams and is not randomly distributed. For the smaller 1st to 3rd order streams that make up the majority of river miles in the state, we use other methods, primarily based on probabilistic sampling, to assess stream conditions. The definition of what a stream is can vary from an intermittent trickle, to a large river.

The water quality in most streams changes from higher to lower from the headwaters to the mouth. Higher gradient streams, which often are headwaters, generally have better water quality than lower gradient streams. As water moves from the headwaters to the mouth, pollutants may accumulate from point and non-point sources. As the gradient slows pollutants may settle out and accumulate and longer residence times may exacerbate adverse biological responses. The ambient network sites provide information only for the sites themselves. Care must be taken in extrapolating that information to the stream as a whole. The ambient network sites were selected to represent reaches. Larger streams have multiple sites to reflect the water quality changes that occur along a stream length. TK - From an editor's viewpoint this is a lot of words to say we only look at larger streams and sampling points are not randomly distributed.

***Issue**: What is the current quantitative status of the Benchmark, and can or should that status be stratified by ecoregion, etc.?*

Current quantitative status:

The data upon which the Benchmark is based are of high quality have been consistently collected from a network of 158 (currently) ambient river monitoring sites statewide located on 4th order and larger streams. Collection of these data has consistently been a core function of the agency's water quality monitoring programs. Although the water quality-monitoring network has been fairly consistent with some sites monitored regularly since the 1940s, sites do occasionally change. Changes are often a result of attempts to address deficiencies in the network or changes in agency focus and priorities. The individual sites in the network are selected to provide data on a particular river or reach. The original network was heavily weighted towards areas that received large point source pollution discharges. This was a result of the early focus of the Agency on addressing point source pollution through permit programs. As the agency has expanded its efforts to address non-point source pollution problems and to identify, monitor and maintain high quality waters the network has been expanded to include more sites in less impacted areas.

Since the proposed Benchmark is partly based on the proportion of total sites in the excellent and good categories, it is extremely sensitive to the location of sites and changes in the network. In this sense the proposed Benchmark is similar to the previous Benchmark. For example, the 1995 Benchmark report, which was based on data from 1986 to 1995, placed 28% of the sites in good to excellent condition. In the 1998 report 37% of the sites were in the good to excellent condition. The casual reader would probably interpret that as 9% of the sites moving from fair or worse to good or better. Closer examination, however, reveals that between those two times 18 sites were dropped from the network and 15 were added. Of the sites that were dropped, only one was excellent and two were good, whereas, of the 15 sites that were added, two are classified as good, and nine as

excellent. These changes in the network reflect the changes mentioned in the previous paragraph. Actually a net of only 2 sites that were included in both reports moved from fair to good. The difference in the percentage of sites in the good to excellent category is almost totally explained by the changes in the network.

Benchmarks are calculated on an annual basis. Changes in Benchmarks will often be interpreted as trends. Changes in the percentage of streams in the good to excellent category would naturally be interpreted by many as a trend of sites improving from fair or less to good or better. A trend is implied. The 1997 trend analysis does indicate water quality improvements: 52% of the sites with statistically significant improving OWQI trends and no sites with statistically significant declining OWQI trends. The trends, however, were not in sites moving from fair to good, but in improvements within the categories.

Stratification: Where possible, stratification of this Benchmark should be consistent with the breakdown used for other Benchmarks, i.e., by ecoregion or major basin, especially those for native fish populations and water quantity. Whether this type of stratification is possible will depend on the number of sites within each stratum. However, because this Benchmark, based on ambient water quality sites on large rivers, is not connected to the sites used for assessing native fish populations, it is not possible to directly relate the results of the two Benchmarks no matter what type of stratification is used.

Issue: *Is there a documented status of the Benchmark at some point in the past that could be used as the historical reference? If so, what is the rationale for selecting this reference status and is it a useful comparison for setting a target now and in the future?*

No. Some of the ambient sites have data collected as far back as 40 years. However, water quality at that time was often worse than current day conditions, so it is not useful as a reference point.

Stream assessments on small streams (1st through 3rd order) have been initiated under the Oregon Plan's monitoring strategy using a probabilistic or randomized design. Part of this strategy includes identifying and sampling reference sites in the same ecoregions. These reference sites are selected to represent streams with little or no human disturbance and thus characterize the highest stream conditions available. These data can provide a useful reference point for comparing current conditions, but it does not indicate historical conditions. In addition it can only be compared to data from other small streams, not large rivers sampled in the ambient network.

Issue: *What is biologically and/or physically possible for the Benchmark's ecological conditions given existing limits, e.g., farms in what used to be forested valleys, Urban Growth Boundaries (UGBs), etc.? If such limits are not fixed, then how should the potential to alter those limits be addressed in the description of ecologically sustainable conditions?*

The link between this Benchmark and ecological sustainability is not well known. First, biological data (fish data collected by ODFW for example) are rarely collected at the same type of large river sites at which ambient water chemistry data are collected. As a result there are little to no data available to clearly determine what level of water quality, based on the OWQI, is necessary to maintain natural

ecological functions. While it is logical that poor water quality reduces ecological sustainability and good to excellent water quality improves ecological sustainability, a scientifically based target for water quality is not available.

Given that the OWQI is calculated so that cold, low nutrient streams receive the highest scores, it is not reasonable or feasible for all streams to reach good to excellent condition based on the OWQI. Some streams, such as the Tualatin River, will likely never attain a good to excellent score because of natural conditions within the watershed.

Water quality has improved across the state consistently since the late 1980s. Some of this improvement can be attributed directly to implementation of water quality improvement plans and activities. All causes for general improvements are not fully understood. It is unlikely that the current rate of water quality improvement can be sustained indefinitely. There will be 30 additional sites that will have sufficient data for trending analysis added to the trending Benchmark over the next few years. Most of these sites are in the good to excellent category and as such may be less likely to show improving water quality trends. This will have the affect of decreasing the percentage of sites with improving trends. If those sites were included now, and had no significant trends, the current percent of improving sites would be 50%. For these reasons, a target of 75% may be very difficult to achieve.

The recommended change in the target Benchmark for percent good to excellent sites is based upon expected changes in the network. Seven sites were added to the network at the request of the Oregon Department of Fish and Wildlife to support Oregon Plan salmonid smolt monitoring. These sites do not really meet our normal criteria for ambient network sites. They are likely to be dropped from the ambient network (at least for statistics). They are all sites with good to excellent water quality. Dropping those sites will reduce the current percentage by 3%. Within the regular ambient network, there are currently 7 sites within 2 points of good. Improving those sites from fair to good would seem to be an appropriate target.

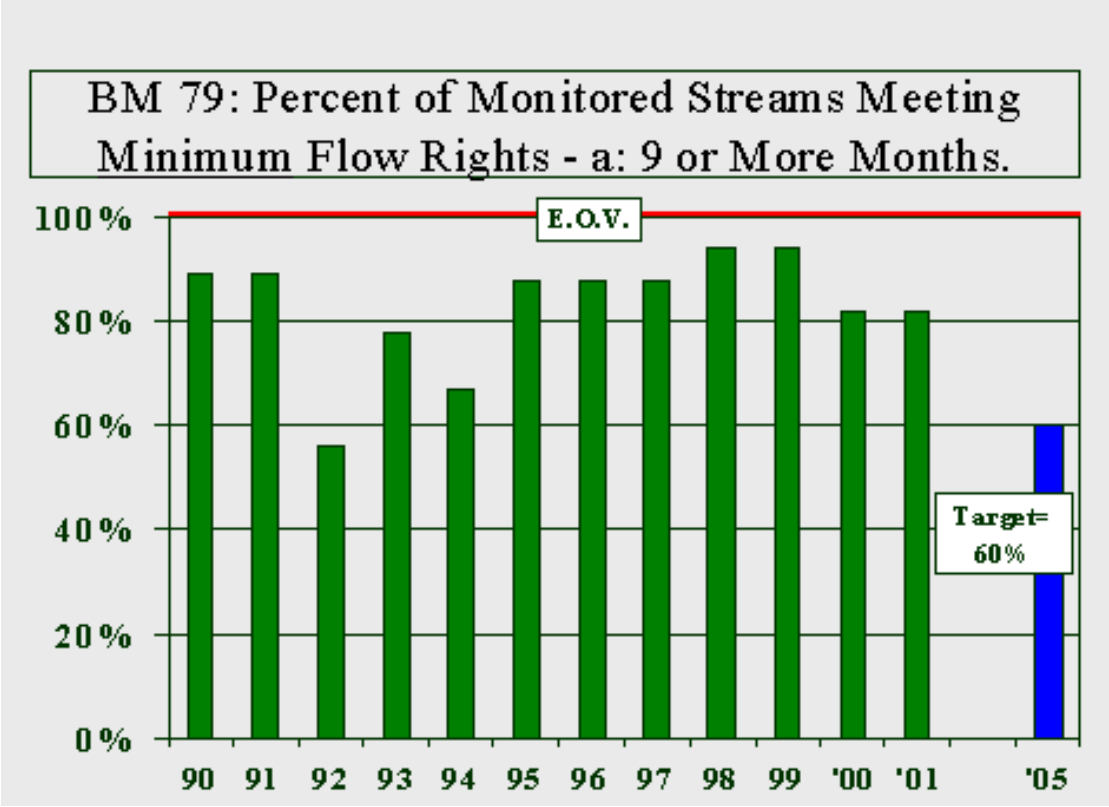
Issue: *What policies are in place to achieve the targets of the Benchmark? Are the policies adequate to achieve the targets?*

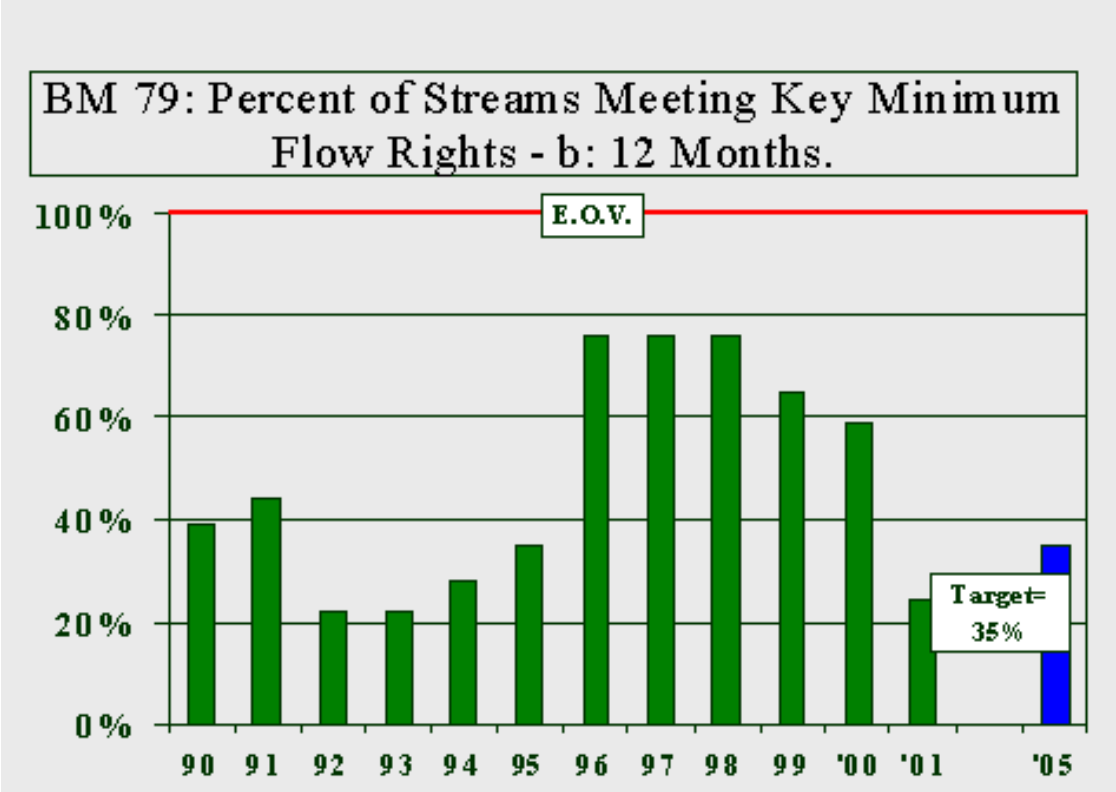
Both federal and state law governs water quality protection. The Clean Water Act as Amended by the Water Quality Act of 1987, Public Law 100-4 establishes the federal requirements for water quality protection. State water quality protection statutes are found in ORS 468.691 through 468.778. These laws are further enacted through federal rules published in the Federal Register and Oregon Administrative Rules (OAR). The OARs for water quality standards are found in OAR 340 Division 41. Both the Federal and state laws are based upon setting standards for water quality that will restore and maintain the beneficial uses of the water. The standards are developed to protect the most sensitive beneficial uses. The specific beneficial uses to be protected are included under the rules. OAR 340-41-026 1(a) establishes an anti-degradation policy for water quality. There is no direct connection between the Oregon Water Quality Index (OWQI), which is the basis for Benchmark #78 and the water quality standards. Many waters that are rated as good or excellent by the OWQI do not fully comply with all standards. The McKenzie River, for example, has the highest OWQI scores of any stream in the state but does not comply in certain locations with the applicable temperature standard for the protection of Bull Trout. Most streams that fall below the "good" category probably

exceed at least one standard, although it is possible to meet all standards and still be in the "fair" or even "poor" category. Improvements in water quality to meet standards would result in improving water quality OWQI trends (78a).

Benchmark #79
***Current Language*: Percent of monitored rivers meeting minimum flow rights**
a. 9 or more months a year
b. 12 months a year

Subject experts: Gary Ball and Debbie Colbert





Ecologically optimal value for sustainability = 100%

Issue: *Does the definition of the Benchmark require any further clarification?*

Yes. The current Benchmark is a measure of how often certain "minimum" instream water rights are met. At each site used in the Benchmark, there is a continuous recording stream gage and an associated "minimum" instream water right.

From the late 1950's through the mid 1980's the Water Resources Board and its successors, the Water Policy Review Board and the Water Resources Commission, adopted minimum perennial stream flows on many streams for the protection of aquatic species. They were set in consultation with the Oregon Department of Fish and Wildlife (ODFW) and with the people in the affected basins as part of basin program updates. In general, they were viewed as the amount of water minimally necessary to keep aquatic species alive.

[Comment: minimum flows are major factors in achieving water quality standards. Maybe this Benchmark is redundant to the previous one. It seems to me that this Benchmark simplifies the issue of flows to the problem of minimum flows, when for many streams in western (and some in eastern) Oregon it is the broader change in the hydrograph TK -needs to be defined, if used. That is a better measure of ecological health. Loss of flood flows and in some case higher summer flows due to dams and increased peak flows in urban areas have changed the ecosystem functions more than summer flows. Could we develop a Benchmark that would measure length of channel with significant change in the "historic" hydrograph? For example, significant change could be defined to include lack of meeting minimum flows, loss of peak flood flows (frequency and intensity), increased peak flows, increased summer flows 30% over base.] TK Hal - this commentary does not show up in any of the recommendations, etc. Suggestions make sense. What to do? Also, the informal, "it seems to me"

should be changed if it stays in the report. Comment needs to be referred to subject expert.

In 1987, the legislature adopted the instream water right (ISWR) concept and directed the Oregon Water Resources Department (OWRD) to convert all existing minimum flows into instream water rights. These converted minimum flows are the "minimum" instream rights of the current Benchmark. In addition, the legislature allowed ODFW, DEQ, and Oregon Parks and Recreation Department (OPRD) to file applications for instream water rights for the values they are charged to protect. However, by 1987, many of the state's streams had been fully appropriated (i.e. more water rights have been granted than summer stream flows can actually support), and there was not enough water remaining to protect in stream values. Consequently, most of these instream water rights are relatively "junior" in priority.

Instream water rights under the new instream water right process have been certified for five of the 17 sites considered under Benchmark 79. Where ODFW has filed an instream water right application, OWRD has generally reduced the amount requested in one or more months to the 50% exceedance level of natural flow. (TK need to define "exceedance level." Refer to subject expert.) ODFW uses the Oregon Method to determine the optimum flows for fish production in the reach of the stream affected for its request. Thus these instream water rights, when certified, do not precisely reflect optimum conditions. However, for purposes here, they will be referred to as optimum instream water rights (ISWRs).

Benchmark 79 was recomputed for water year 1998, the best in the last 10, using those five sites. Using the minimum ISWRs, 100% were met 9 months, and 60% were met 12 months. Using the optimum ISWRs, 60% were met 9 months and 20% were met 12 months.

Benchmark 79 was recomputed for water year 1992, the worst in the last 10, using those five sites. Using the minimum ISWR's, 60% were met 9 months, and 40% were met 12 months. Using the optimum ISWRs, 0% was met 9 months and 0% was met 12 months.

This comparison demonstrates that the percentage of time instream water rights are met varies considerably depending on the type of ISWR used (minimum versus optimum). TK Hal - This tautology seems unnecessary. Of course different standards will yield different results. Again, refer to subject expert.

This comparison between the Benchmark results using minimum versus optimum ISWRs illustrates the importance of stable and consistent data for assessing Benchmarks. Some other Benchmarks are in a state of flux, making it impossible for them to tell a consistent story over time. TK Again, what's the purpose? It's, generally, not true and has nothing to do with the comparison from which the author's finding is drawn. Again, refer to subject expert.

Issue: *What is the current quantitative status of the Benchmark, and can or should that status be stratified by ecoregion, etc?*

The US Geological Survey computes the stream flow data for the sites used by the Benchmark. The data could be stratified by ecoregion.

Issue: *Is there a documented status of the Benchmark at some point in the past that could be used as the historical reference? If so, what is the rationale for selecting this reference status and is it a useful comparison for setting a target now and in the future?*

The Benchmark could be computed back to 1961 including all sites currently used. The Benchmark could also be computed using 13 of the 17 sites back to 1928. This Benchmark is highly dependent on climatic conditions; therefore, utilizing moving averages to eliminate some of the annual variability would be a useful reference for evaluating this Benchmark.

Issue: *What is biologically and/or physically possible for the Benchmark's ecological conditions given existing limits, e.g., farms in what used to be forested valleys, Urban Growth Boundaries (UGBs), etc.? If such limits are not fixed, then how should the potential to alter those limits be addressed in the description of ecologically sustainable conditions?*

The prior existing water rights can limit the amount of water available to maintain instream flows. These rights can be transferred to instream rights with consent of the owner. The Oregon Water Trust, a nonprofit organization, is actively involved in purchasing and leasing out-of-stream rights to convert to instream use.

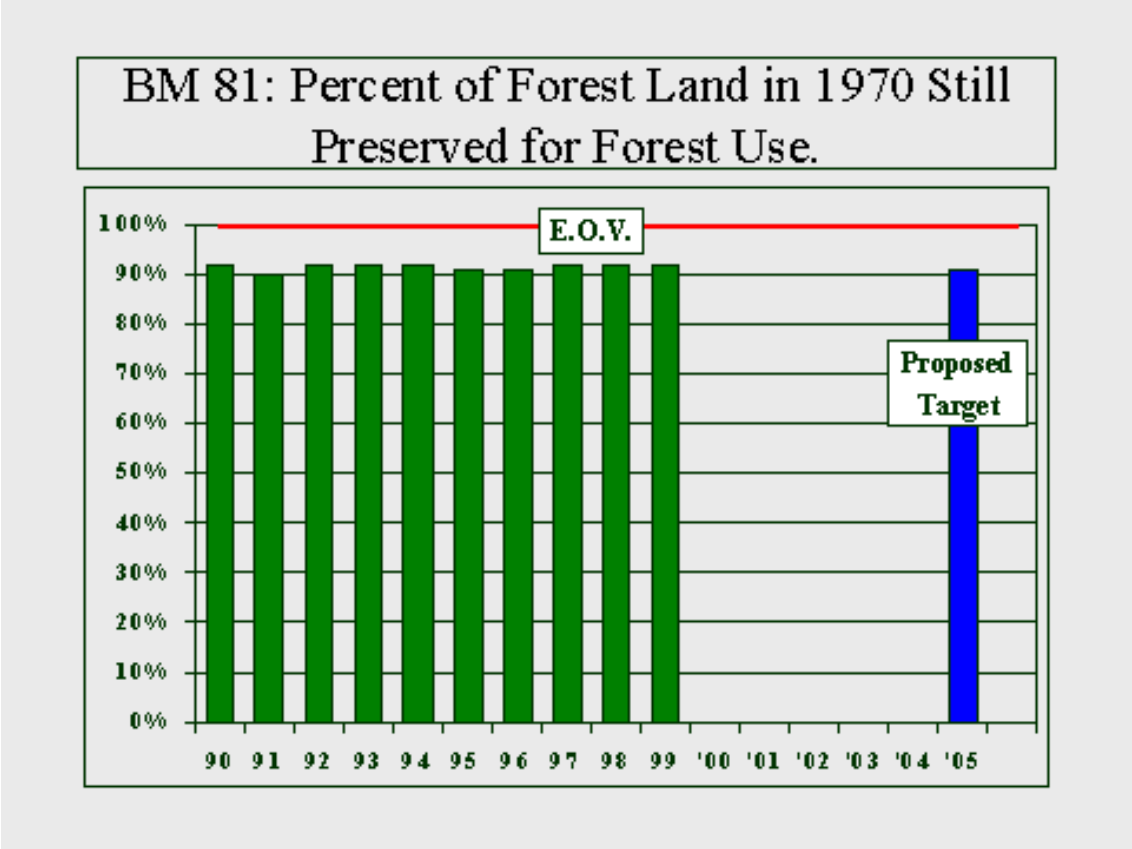
Issue: *What policies are in place to achieve the targets of the Benchmark? Are the policies adequate to achieve the targets?*

The OWRD, as part of its 2001-2003 Strategic Plan for Managing Oregon's Water Resources, has established stream flow restoration priority areas, encourages purchase, lease and gift of out of stream rights to instream use, and coordinates with the Army Corps of Engineers to maximize the benefits of storage releases for instream flow needs. However, there are statutory constraints on the OWRD in achieving the Benchmark target.

The OWRD manages the water resources of the state according to the existing water rights of record using the doctrine of prior appropriation. Instream water rights establish flow levels to stay in a stream on a month-by-month basis and are usually set for a certain stream reach. Instream water rights are not guarantees that a certain quantity of water will be present in a stream. When the quantity of water in a stream is less than the instream water right, OWRD will require junior water right holders to stop diverting water. Under Oregon law, an instream water right cannot affect a use of water with a senior priority date. Therefore, instream water rights cannot increase stream flows and do not guarantee minimum stream flows in stream reaches. Other tools must be utilized to restore stream flows in reaches where water quantity falls below quantities needed to ensure that instream water rights are met. OWRD promotes stream flow restoration through water use efficiency and conservation programs and water right leases and transfers. However, these flow restoration tools rely on voluntary participation by water right holders and cannot be prescribed by OWRD

Benchmark #81
***Current Language*: Percent of Oregon forestland in 1970 still preserved for forest use.**

Subject experts: Kevin Birch, Hal Salwasser, and David Morman



Proposed future change to Benchmark: Acreage of forest by type and structural stage by ecoregion. (This is currently a developmental Benchmark.)

Ecologically optimal value for sustainability = 100% for current Benchmark.

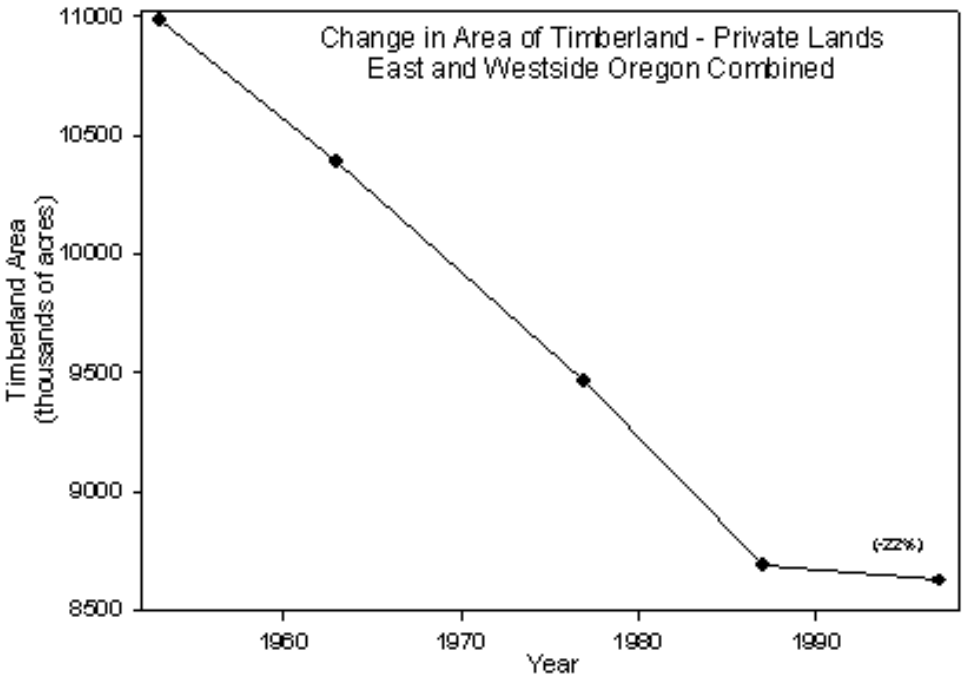
ODF staff feel that 90% of 1970 or perhaps 1950 forested area is all that is possible. The proposal for 100% as ecologically optimal assumes that any losses of forest cover or land in forest use from 1970 or 1950 levels is offset by afforestation on lands currently devoted to non-forest use.

Issue: *Does the definition of the Benchmark require any further clarification?*

Yes. The public is concerned that we are losing forests and forestland values to residential conversion and unsustainable logging. Maintaining the size of the forestland base is a critical element of providing a sustainable flow of biological, economic, and social goods and services from forests. As opposed to fragmenting and diminishing the forest through other land uses, an intact forest, intensively managed or in nature reserves, provides many benefits over other land uses including greater biological diversity, clean water, and carbon storage. However, he current Benchmark does not provide information on the quality of the forest for a full range of values such as carbon storage, wildlife habitat, and wood production.

The way that data are currently displayed does not show the nature of land conversion impacts to forests nor does it indicate whether we are achieving policy goals. The time series of data needs more historic data and public and private lands need to be displayed through different bars or lines. Publicly owned forestlands are not available for conversion to other uses and they are under different

management regimes than private forestlands. Displaying public and private lands together masks the relevant information. See the graph below or an example.



Source: Donnegan, 2001. Assessing temporal trends in Forest Inventory and Analysis data: Applications to Criteria and Indicators. Wood Compatibility Workshop, Dec. 5-7, 2001. Base data set: Resource Planning Act, 2000.

Issue: *What is the current quantitative status of the Benchmark, and can or should that status be stratified by ecoregion, etc?*

Status of Data:

Currently, data for this Benchmark were obtained from the Oregon Department of Forestry Annual Reports. Federal land base estimates were obtained from information published in the Northwest Forest Plan for western Oregon and estimates for eastern Oregon come from individual plans for the National Forests. Private land base estimates were obtained by using plot sample information collected and compiled by the USDA Forest Service Pacific Northwest Research Station, Forest Inventory and Analysis program (FIA Data).

In 2000, the USDA Forest Service combined data from two permanent plot inventories that cover all the forest ownerships in Oregon into one database for reports published through the Resource Planning Act (RPA Data). Unfortunately the two database designs are not identical and therefore present problems when compiled into a single database. Many errors have been found in the RPA data and the Oregon Department of Forestry has judged that the data are not accurate enough to include the new information in its annual reports. Therefore, land base estimates in the annual reports and the Benchmark will not be changed until the Forest Inventory and Analysis program reconciles errors created by combining data sources.

Data For Structural Stages (Developmental Benchmark # 2027):

The SOER science panel suggested that Oregon create a Benchmark that could measure forest quality. This Benchmark would include information on structural stages, i.e., replace the single bar with a stacked bar of condition classes that totals to the percent of forest still in forest use. The stacked bar could also show the percent of original forest converted to other uses. Thus, a single graph for this Benchmark could track changes in total forest cover and the proportion of forest cover in condition classes such as: grass-forb-tree seedling class, tree sapling-pole class, mature tree class, and old forest class. The portion of the stacked bar that depicts original forest no longer in forest cover or use would track the forest lost to other uses. Such a refinement would advance Developmental Benchmark 2027 to replace existing Benchmark 81.

Accurate data for structural stages or condition classes are not yet available from the USDA Forest Inventory and Analysis (FIA) program. The FIA is currently trying to complete work on a 1997 inventory of all nonfederal forestlands, and combine it with data from the federal Continuous Vegetation Survey (CVS). The anticipated product will be a single database ("The Unified Database") that can be used to establish baseline conditions across all forest ownerships. The project is currently behind schedule and completion estimates are not available.

The amount of forestland in the ecoregions of western Oregon is available from a photo sample conducted jointly by the Oregon Department of Forestry and FIA. Data are available for the years 1973, 1982, 1994, and 2000. Estimates for eastern Oregon are not available at this time.

Estimates of the forested area occupied by different structural stages or condition classes may not be very accurate. Getting historic information from both FIA and CVS into a consistent format may not possible. Due to changes in data collection methods and compilation problems, trend information may show artificial shifts in size classes that are associated with measurement changes or errors. This would impact the value of historic trend estimates but would not hinder establishment of a baseline of current conditions to reference future trends.

If meaningful historical information on structural stages can be obtained for all Oregon forest types, such data could serve as a knowledge base, which could then be used in a separate policy discussion. The discussion would have as its purpose to establish Benchmark targets for a desired future condition or range of conditions for forest structural stages. The targets would integrate what is ecologically possible with goals for economic and social components of forest sustainability.

Issue: *Is there a documented status of the Benchmark at some point in the past that could be used as the historical reference? If so, what is the rationale for selecting this reference status and is it a useful comparison for setting a target now and in the future?*

The historic extent of the forest is available from the original land survey done in Oregon . Categories in the data set include: merchantable-timber area, woodland, open country, burned area, cut area, and barren. The data are available by county and could be used to estimate the historic extent of forests in each ecoregion. However, merchantability standards and sample design were different than those used today, therefore, comparisons with current data would have accuracy limitations.

Issue: *What is biologically and/or physically possible for the Benchmark's ecological conditions given existing limits, e.g., farms in what used to be forested valleys, Urban Growth Boundaries (UGBs), etc.? If such limits are not fixed, then how should the potential to alter those limits be addressed in the description of ecologically sustainable conditions?*

The physical expansion of forestland is limited by several factors, naturally by the area of land with the biological capacity to grow trees and artificially by the extent of potential forestlands in agriculture and residential/urban development. Currently, about two percent of the non-federal forestland base is in areas that are zoned for rural residential development or urban expansion (within UGBs). Afforestation of non-forestland is not expected to be sufficient to offset this loss. Therefore, it may not be biologically or physically possible to return to 1970 or 1950 levels of land in forest use. According to the above criteria, unless some land currently in agriculture reverts to forest, it may only be possible to maintain the existing area of forestland minus that 1-2%. The policy target for this Benchmark may be capped at 90% by these limits.

Having said this, the ecologically optimal value of this Benchmark is set at 100% in recognition that Oregon has a large portion of its original forest cover still in place (on the order of 90% of original) and also has the capability to offset future forestland losses through policies that would encourage "no net loss," or an acre of recovered forest for each acre lost to development. From the perspective of ecological optimality of forests, the more land in forest cover and forest use the better.

Issue: *What policies are in place to achieve the targets of the Benchmark? Are the policies adequate to achieve the targets?*

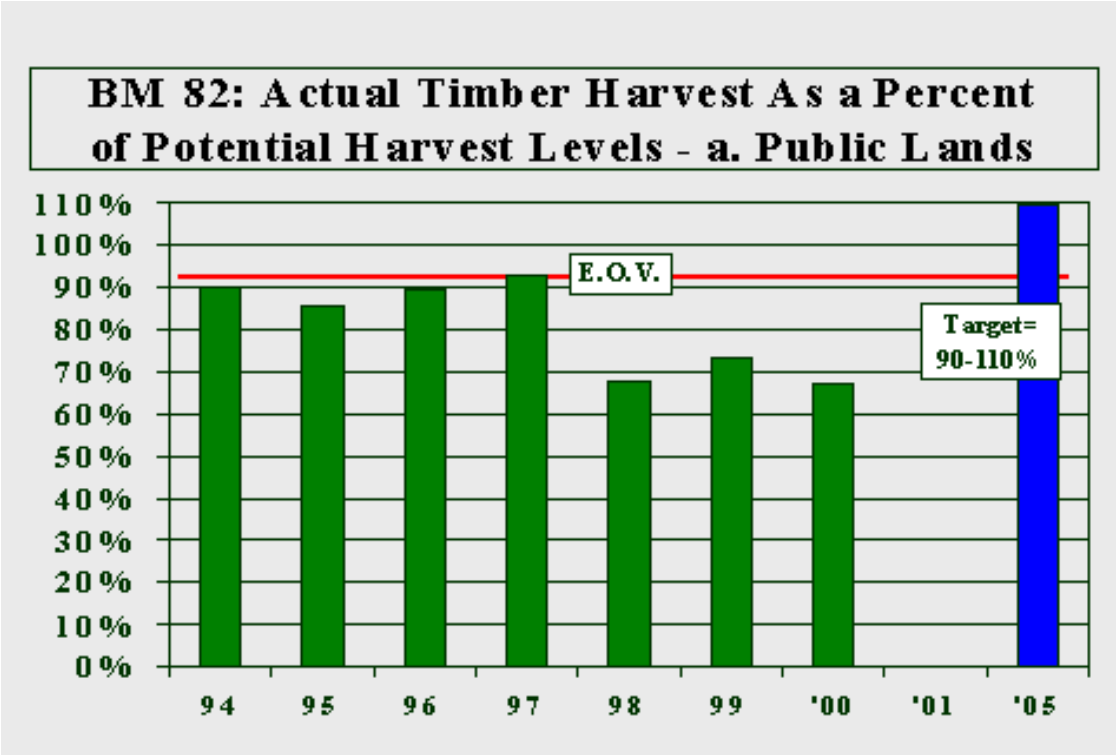
Federal policies precluding development of federal forestlands and Oregon's land use-planning laws and rules are the mechanisms used to achieve the goals of this Benchmark. The land use laws are currently achieving the targets for this Benchmark. However, some elected officials and citizens feel that the land use system is too restrictive. Bills have passed during recent legislative sessions that would have weakened the existing laws' ability to achieve these targets. The Governor has vetoed the bills in order to maintain the ability of the land use system to limit the extent of growth. Oregon's population is expected to grow by about a million people in the next 20 years. That means building two new cities the size of Portland or ten new cities the size of Salem. With that type of growth pressure and the potential for diminishing legislative support, it is uncertain whether the land use planning system in place will be strong enough to meet the targets of this Benchmark. There is no policy in place to set a no net loss target for forestland.

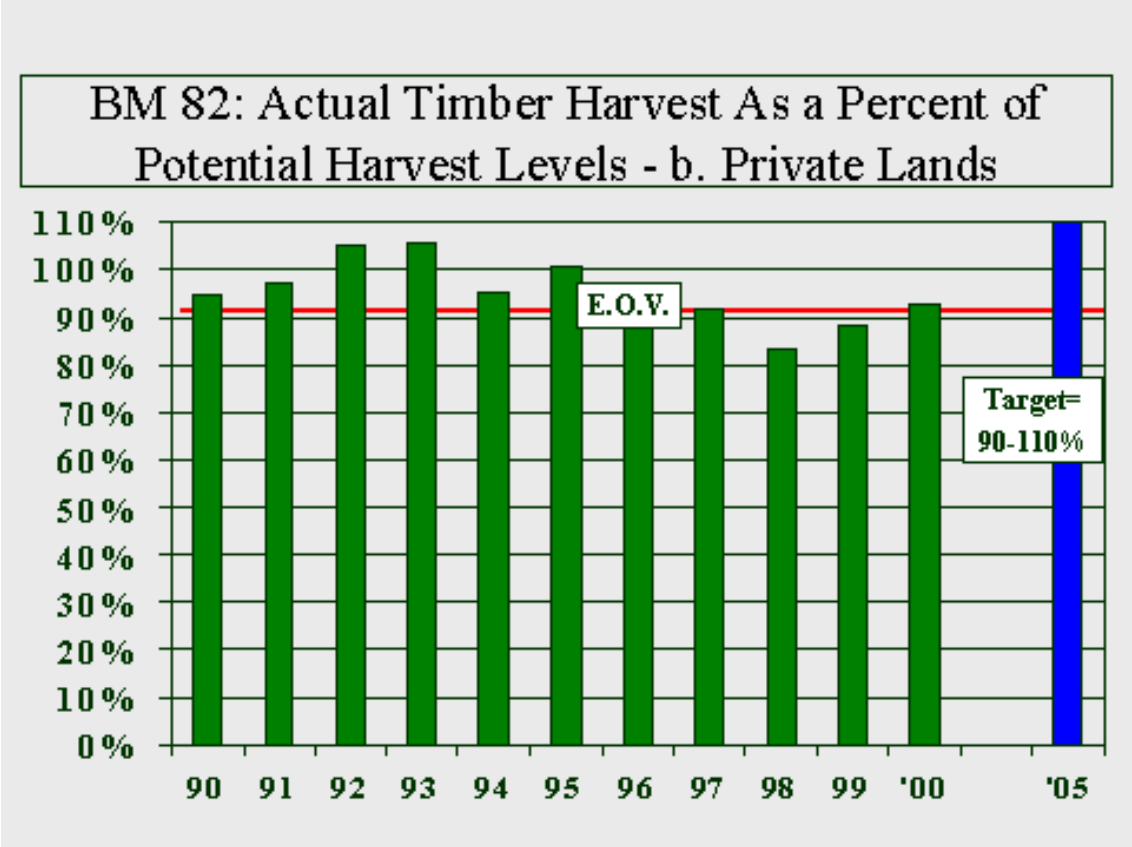
Additional uncertainties are on the horizon for Oregon's land use protections. While the voter-passed Measure 7, a "takings" compensation measure, was ruled unconstitutional, few believe this issue will disappear. If a takings measure goes into effect, protections for Oregon's farm and forestlands will be diminished. Turnover in elected officials in coming years adds more uncertainty to this picture.

Benchmark # 82
***Current Language*: Actual timber harvest as a percent of potential harvest levels Under current plans and policies**
a. Public lands

b. Private lands

Subject experts: Kevin Birch, Hal Salwasser, and David Morman





Ecologically optimal value for sustainability = 100%

Issue: *Does the definition of the Benchmark require any further clarification?*

Yes. This Benchmark, as defined above, addresses the second part of the Science Panel's definition of environmental health: sustainable production of goods and services for human use. Timber is very important to Oregon's economies and communities and Oregonians are concerned that forests not be harvested at an unsustainable rate. However, they also want timber to be harvested at a rate that maintains the jobs and benefits created for Oregon's economies, communities and environments by the forest industry.

The graph showing harvest as a percent of the sustainable timber harvest is misleading because it does not depict the periodic changes that occur in sustainable and potential harvest levels over time. These changes occur as more or less timberland is devoted to non-commercial uses and as productivity increases lift sustainable harvest levels on existing commercial forestlands. The potential harvest level for each year under current plans and policies, i.e., the denominator in the above data, needs to be explicitly shown on the graph, and a discussion of why the potential and sustainable harvest level changes needs to be included in the text.

Annual harvest volume and the sustainable harvest level needs to be displayed as either board foot or cubic foot volume, not as a percent. Volume growth is an initial estimate of the maximum potential and sustainable harvest level. You cannot harvest more timber than the forest grows for long periods of time. So, estimates of annual growth could also be added to the graph to provide more information on what is biologically possible. Then, differences between actual harvest, potential sustainable harvest levels defined by plans and landowner intents, and growth would show several important things: whether the standing timber volume and forest biomass is increasing or decreasing, the degree to which harvest levels are sustainable, and the amount of wood biomass in the forest that is dedicated to non-timber values of the forests, such as carbon storage, biological diversity and water quality. This single, augmented graph could have 3 bars or lines to convey the vital information on an improved Benchmark.

The way that data are currently displayed does not show the nature of land conversion impacts to forests nor does it indicate whether we are achieving policy goals. The time series of data needs more historic data and public and private lands need to be displayed through different bars or lines. Publicly owned forestlands are not available for conversion to other uses and they are under different management regimes than private forestlands. Displaying public and private lands together masks the relevant information. (Editor's note: The Progress Board will include acreage when the data are reported.)

Issue: *What is the current quantitative status of the Benchmark, and can or should that status be stratified by ecoregion, etc?*

Data for this Benchmark can be obtained from Oregon Department of Forestry Annual Reports. Federal harvest estimates are obtained from annual information supplied by federal agencies. Private harvests are obtained from Oregon Department of Revenue timber tax accounts. The data are available by county. While county boundaries are not an exact match for ecoregion boundaries, the data can be used to make estimates of timber harvest by ecoregion and ownership class. Estimates of potential and sustainable timber harvest levels on federal forests are available from their published plans. Estimates of sustainable timber harvests on private lands are published in *Timber for Oregon's*

Tomorrow: The 12989 Update (Session, Johnson, Beuter, Greber and Lettman. 1990 OSU Forest Research Lab).

Estimates of growth may not be very accurate at this time but analytical tools are improving each year. Getting historic information from both Forest Inventory and Analysis and Continuous Vegetation Survey into a consistent format may be difficult.

Issue: *Is there a documented status of the Benchmark at some point in the past that could be used as the historical reference? If so, what is the rationale for selecting this reference status and is it a useful comparison for setting a target now and in the future?*

Historical timber harvests are available from the Oregon Department of Forestry back to the 1940's. Sustainable timber harvest levels are available from published sources for several points in time including:

1. Beuter, Johnson, and Scheurman. 1976. Timber for Oregon's Tomorrow. OSU Forest Research Lab.
2. Sessions, Johnson, Beuter, Greber, and Lettman. 1989. Timber for Oregon's Tomorrow: The 1989 Update. OSU Forest Research Lab
3. Adams, Schillinger, and Latta. 1999. Western Oregon Timber Supply Study. OSU.

Issue: *What is biologically and/or physically possible for the Benchmark's ecological conditions given existing limits, e.g., farms in what used to be forested valleys, Urban Growth Boundaries (UGBs), etc.? If such limits are not fixed, then how should the potential to alter those limits be addressed in the description of ecologically sustainable conditions?*

Under current plans and policies, the biological capacity of the forest to produce and yield wood far exceeds what is available for potential harvest. Since this Benchmark is defined by what plans and policies say is potential and sustainable over time, 100% is what is ecologically optimal (however, ecological optimality may not be relevant to this Benchmark for this reason). If the Benchmark is defined in such a way to include estimates of growth and improvements in growth that increase potential and sustainable harvest levels then it is conceivable that the denominator for this Benchmark could increase over time. This is in fact what private forest owners are doing with productivity improvements. The Benchmark as currently defined does not explicitly show this possibility, i.e., that potential and sustainable harvest could increase over time.

Because our social policies, i.e., forest practice act rules and federal forest policies, reserve large volumes of wood in forests for values other than wood products, the planned potential and sustainable harvest levels in any given year already reflect an approach to determining what is ecologically optimal for harvest. Thus the ecologically optimal value for this Benchmark is set at 100%, acknowledging that over time the sustainable level can and does change due to new information, policy changes, or increased productivity.

Issue: *What policies are in place to achieve the targets of the Benchmark? Are the policies adequate to achieve the targets?*

The policies in place that help to achieve targets for this Benchmark include the Oregon Forest Practices Act (FPA), the Oregon Land Use Laws, and the National Forest Management Act (NFMA), Oregon and California Lands Act, and Federal Land Policy and Management Act (FLPMA). The FPA does not regulate the amount of timber that can be harvested. However, it does require that landowners promptly reforest after harvesting so that a future crop of timber is continuously being grown. The Land Use laws require forestland to be zoned for commercial timber production and help to maintain the land in forest use over time. However, market forces are left to determine the actual amount of timber harvested on private lands in any given year. That harvest level could be above sustainable levels over the short term as long as merchantable timber remains on the land.

NFMA requires that timber be harvested at or below sustainable levels. However, there is no requirement that timber must be harvested. Therefore, federal timber harvests can and often do fall far below sustainable levels. Federal forest plans and practices in Oregon have shifted dramatically in the past decade toward preservation and restoration of old forest conditions and away from attention to the production of wood and associated jobs and economic benefits.

2003 Benchmark Update

Contact: Kevin Birch

Target: Sustainable harvest level under current plans and policies plus or minus 10% ***Data source:*** Oregon Department of Forestry and Oregon State University

The biological capacity of the forest to produce and yield wood (i.e., Bio Potential in the graph above) far exceeds what is available for harvest under current plans and policies. Because our social policies, i.e., forest practice act rules and federal forest policies, reserve large volumes of wood in forests for values other than wood products, the sustainable harvest levels in any given year reflect an approach to determining what is ecologically and socially optimal for harvest. Thus the target for this Benchmark is set at 100% of the planned sustainable harvest, acknowledging that over time the sustainable level can and does change due to new information, policy changes, or increased productivity.

Changes in the sustainable timber harvest levels (i.e., Sustain (Pvt) and Sustain (Pub) in the graph above) occur periodically as more or less timberland is devoted to non-commercial uses in plans and policies and as productivity increases lift sustainable harvest levels on existing commercial forestlands. The sustainable harvest level for each year under current plans and policies is used as the denominator in the percent sustainable harvest calculations for the Benchmark. Current Actual timber harvest levels are below sustainable levels on both public and private lands.

Data Sources:

Actual timber harvests: Oregon Department of Forestry, Annual Reports.

Sustainable Forest Industry: Sessions J. (Coord.) 1991. Timber for Oregon's Tomorrow: The 1989 Update. OSU Forest Research Lab.

Sustainable Nonindustrial Private: Greeber, Johnson, and Lettman. 1990. Conservation Plans for the Northern Spotted Owl and Other Forest Management Proposals in Oregon: The Economics of Changing Timber Availability. OSU Forest Research Lab.

Sustainable Current Other Public: Oregon Dept. of Forestry and Other Sources

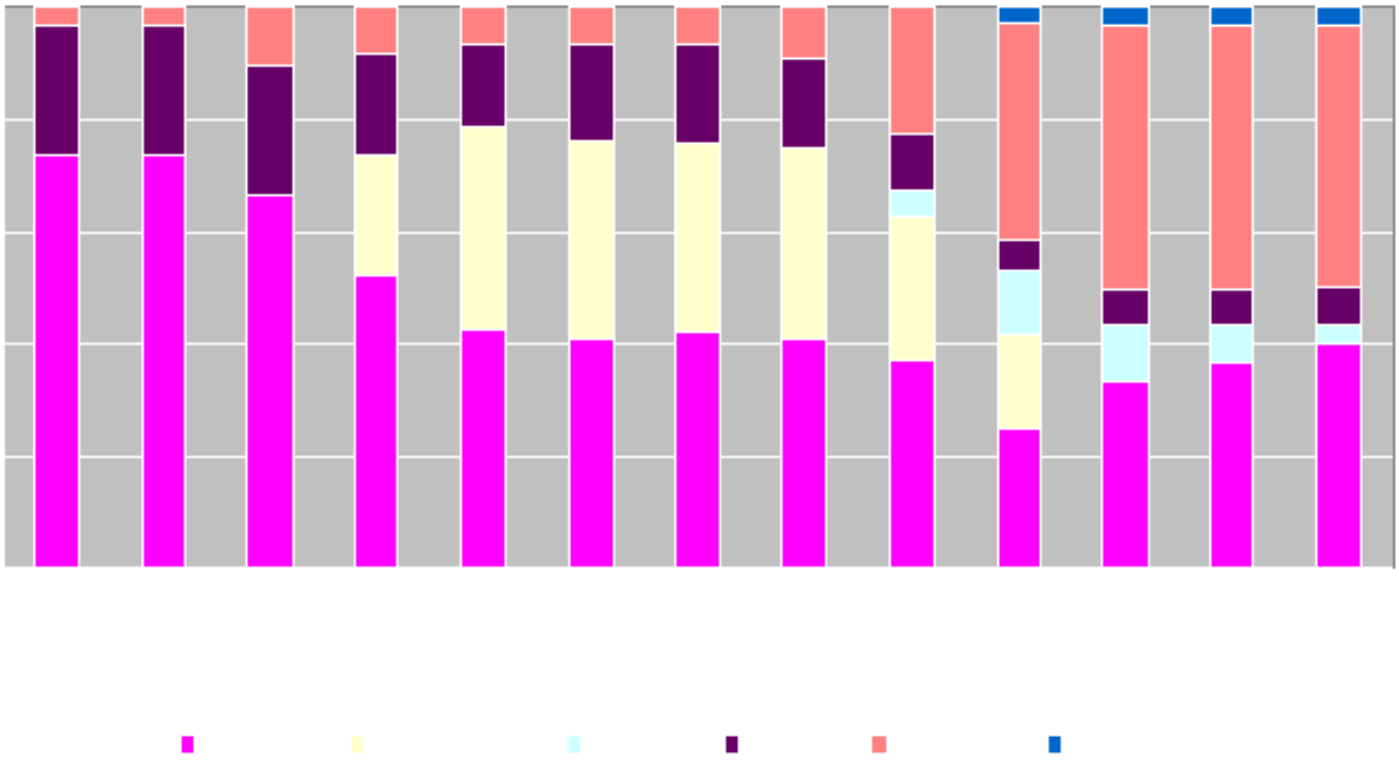
Sustainable Current Federal: USDA Forest Service, Bureau of Land Management, and other

Pre-1980 Sustainable and Biological Potential: Oregon Department of Forestry. 1980. Forestry in Oregon: 1980 Timber Supply Assessment. ODF Salem, OR.

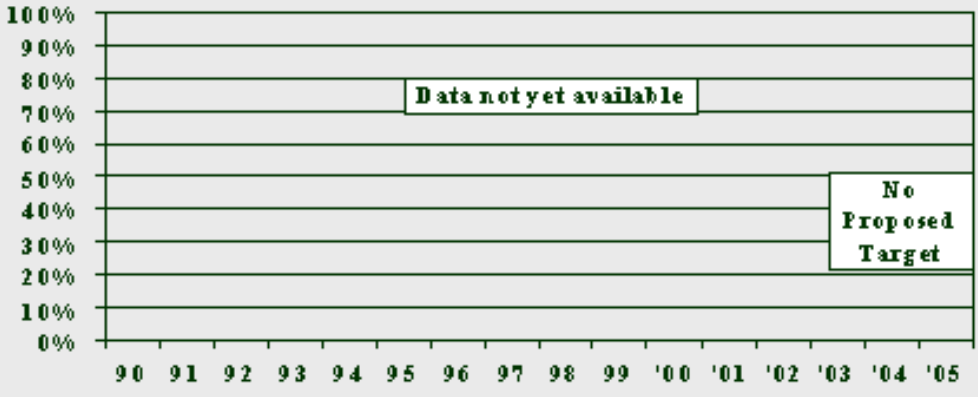
Benchmark 85:
Pre-SOER Language: **Percent of monitored wild and native fish populations that are classified as healthy.**
a. Salmon and steelhead populations
b. Other populations

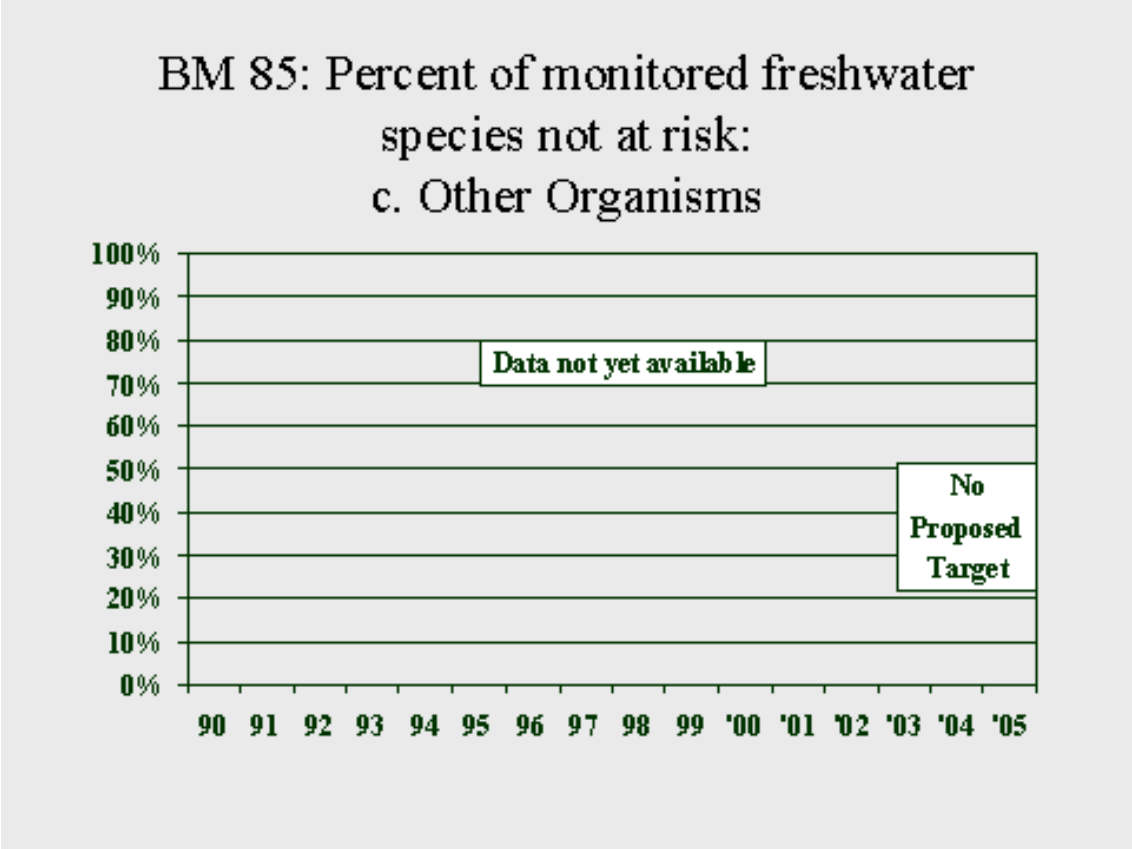
Proposed Language: **Percent of monitored freshwater species not at risk**
a) salmonids
b) other fish
c) other organisms (amphibians, mollusks, etc.)

Subject experts: Jay Nicholas and Gordon Reeves. (Modified in response to July 3, 2002 Fish Summit)



Note: Science working group stills needs to work on ecologically possible/optimal values for this Benchmark.





Background on Benchmark 85
The following comments relate to data that have been provided for Benchmark 85 as it currently exists (Pre-SOER language).

- The Oregon Department of Fish And Wildlife is the agency responsible for providing data for this Benchmark.
    - No documentation exists regarding the criteria for classification of populations as healthy or not healthy. Several individual biologists using different thought processes probably exercised judgment.

The July 3, 2002 fish benchmarks workshop consensus was that species not listed by state or federal agencies as at risk would constitute the criterion for this Benchmark. Subsequent discussion raises the concern that the NatureServe ranking system would be a sounder ecological criterion for inclusion or exclusion from this list. In any case, we need to specify the subset of all species that this Benchmark is tracking, i.e., the monitored species.

- the actual number of populations considered in developing the two percentages reported for this Benchmark is not known.
- ODFW did not have a systematic rationale for monitoring specific populations to represent the statewide status of native fish. These simply were populations that were being tracked at unknown frequencies and intensity levels. The methods and accuracy of monitoring varied considerably among populations. Therefore, the Benchmark may not be representative of the statewide condition of fish and/or native salmon and steelhead populations. Finally, the data available for this Benchmark may not be sufficient to stratify and represent conditions for fish at the ecoregion scale.

- The methodology used to calculate the values reported for this Benchmark has not been clearly documented.
- The modification proposed here should rectify shortcomings in the previous Benchmark.

Assumptions made by the Science Working Group

These comments are related the general concept of a Benchmark that could be developed to represent health of Oregon's native fish, not necessarily to the current Benchmark 85.

The working group's understanding of the term healthy does not necessarily include capacity to provide for a harvest of the population in fisheries.

The term healthy may not be based on characteristics of the population in a single year, because considerable annual and cyclic variation in populations is natural and expected to occur due to such factors as variation in climate and ocean conditions. Placement of a population in the not-healthy category may be made based on performance over a period of years in context with other populations and regional environmental conditions.

These concerns would be addressed with the change from "healthy" to "not at risk" In the definition of the Benchmark.

Long term directional change in patterns of variation (e.g., climate change, global warming), would also influence status of populations.

Issue: *Does the definition of the Benchmark require any further clarification?*

Note to subject experts: We need to discuss why ESUs and not populations for salmonids, or vice versa. What about the other taxa? The intention of the Benchmark is to provide a framework for public discussion of the state of the environment. As such, the Benchmark should be designed to fairly represent the condition of native freshwater species (native salmon and steelhead populations, native non-salmon-and-steelhead populations, and other freshwater organisms,) at the stated scale, be it statewide, ecoregion, or basin.

Does this Benchmark measure the right thing? We believe it would, if the change to "not at risk" is accepted. Is further discussion of this Benchmark needed? Probably. For example, fish populations that are tracked under this Benchmark should be selected with consideration of sample sites that are tracked for water quality (Benchmark 78) and water quantity (Benchmark 79), perhaps, Benchmarks 81 and 82, and invasive species Benchmark 89. Fish populations are thought to be an integrator of environmental conditions across the landscape, i.e., influenced by multiple factors such as water quality, stream flow, habitat conditions, and exotic species invasions. As such, the possible or likely influence of these other environmental Benchmark conditions on the status of fish populations should be considered when data sample sites are selected.

Issue: *What is the current quantitative status of the Benchmark, and can or should that status be stratified by ecoregion, basin or watershed?*

The current status of the Benchmark, as reported by ODFW, is that 45% of monitored native (non-salmon-and -steelhead) fish populations are healthy and 23% of native salmon and steelhead populations are healthy. This Benchmark, if representative, is useful at the statewide level, but would be more informative if available at the ecoregion or basin level (there are 18 basins in Oregon). At present, the Benchmark may not be representative at the statewide scale, and data may not be suitable for representative stratification at the ecoregion or basin scale.

Issue: *Is there a documented status of the Benchmark at some point in the past that could be used as the historical reference? If so, what is the rationale for selecting this reference status and is it a useful comparison for setting a target for now and in the future?*

There is no documented status of the Benchmark under pre-settlement conditions, but inferences may be made regarding the probable condition of fish populations and habitats that existed then. Such inferences may provide a basis for suggesting sideboards for ecologically optimal or ecologically sustainable values for this Benchmark.

First, what is meant by ecologically optimal or ecologically sustainable for this Benchmark? A statement that is something like this could answer the question we are asking.

- *Ecological processes and functions in Oregon's environment would be sustainable if at least XX % of salmon and steelhead populations were healthy, i.e., not at risk, and YY % of non-salmon-and-steelhead populations was healthy, i.e., not at risk.*

How might we define ecologically optimal values for these percentages?

Studies of disturbance and forest succession regimes in Oregon's coast range basins suggest that an average of roughly 40% of sub watersheds were not very productive for fish because they were either recently disturbed by fire and/or landslides or because they were in very old growth forests characterized by aggraded stream channels and may have had little sunlight through dense forest canopy to stimulate primary production.

At the sub-watershed scale, e.g., 3rd or 4th order streams, not all areas were particularly productive spawning or rearing areas for native fish at any point in time. There was, however, an ongoing evolution of the aquatic habitats at this sub watershed scale from not very productive to productive, and then again to not-very-productive. The very productive sub watersheds (inference: healthy fish populations) within a basin were not the same locations through time. But it is likely that *most* basins, as composites of sub watersheds, remained generally productive (healthy) for native fish because the scale of landscape disturbance and forest succession only occasionally covered an entire basin.

If we infer that fish populations are more likely to be defined at a basin than at a sub-watershed scale, we might therefore conclude that *most* populations were healthy in pre settlement conditions, recognizing that an average of 40 % of the sub-watersheds in a basin were not contributing much to the health of the population at any point in time.

What does *most* of the populations mean? Lacking documentation of historic conditions,

metapopulation theory suggests that *not all* populations within the range of an evolutionarily significant unit (ESU) must be healthy at the same time for the species to persist. Like the evolution of sub-watersheds in a basin over time from productive to non-productive to productive again, populations were probably evolving through these conditions based on local environmental conditions. As long as the environments and populations are allowed to evolve in natural patterns, the environments, populations and species were sustainable.

How does this information help us suggest percentages of fish populations that would be ecologically optimal/sustainable? Because most (but not all) fish populations were probably healthy historically, we could infer that an *upper boundary* of ecological sustainability for this Benchmark would be for most (but not all) of the fish populations to be healthy.

Our guess is that the percentage of populations that were healthy in pre-settlement Oregon (i.e., most but not all) was probably above 90%. This value - 90% - could frame the *upper limit* for ecological sustainability of this Benchmark.

The *lower limit* of ecological sustainability for this Benchmark cannot be inferred from science. Today, unlike during pre-settlement conditions in Oregon, evolution of sub-watersheds from productive to less-productive conditions and from less-productive back to more productive conditions is occurring at a different rate than under which the fish evolved. The resiliency of fish populations and their ability to re-colonize and adapt to current rates of landscape disturbance and succession conditions is not understood.

The *lower limit* of ecological sustainability for this Benchmark is probably somewhat below the 90% level, but we do not know, scientifically, how to define the lower limit.

Issue: *What is biologically and/or physically possible for the Benchmark's ecological conditions given existing limits, e.g., dams on major rivers, farms in what used to be forested valleys, Urban Growth Boundaries, etc.? If such limits are not fixed, then how should the potential to alter those limits be addressed in the description of ecologically sustainable conditions?*

We do not know what values are attainable for this Benchmark under current ecological conditions in Oregon. First, we believe that different values may be attainable in different ecoregions throughout the state, because of differences in the degree to which human development has occurred in the different areas. Second, this Benchmark is driven by the manner in which ODFW defines population units within ESUs. Depending on the assumptions one makes, it is possible to define relatively many or relatively few populations within ecoregions. Depending on how one defines populations, therefore, will influence the currently attainable values for the Benchmark.

Issue: *Are there laws or policies that might legally dictate the condition of this Benchmark?*

Yes. Related Laws and Policies that dictate or advise on what the condition of these populations should be are:
1. Federal and State Endangered Species acts
2. Oregon Department of Fish and Wildlife Statutes and Administrative Rules

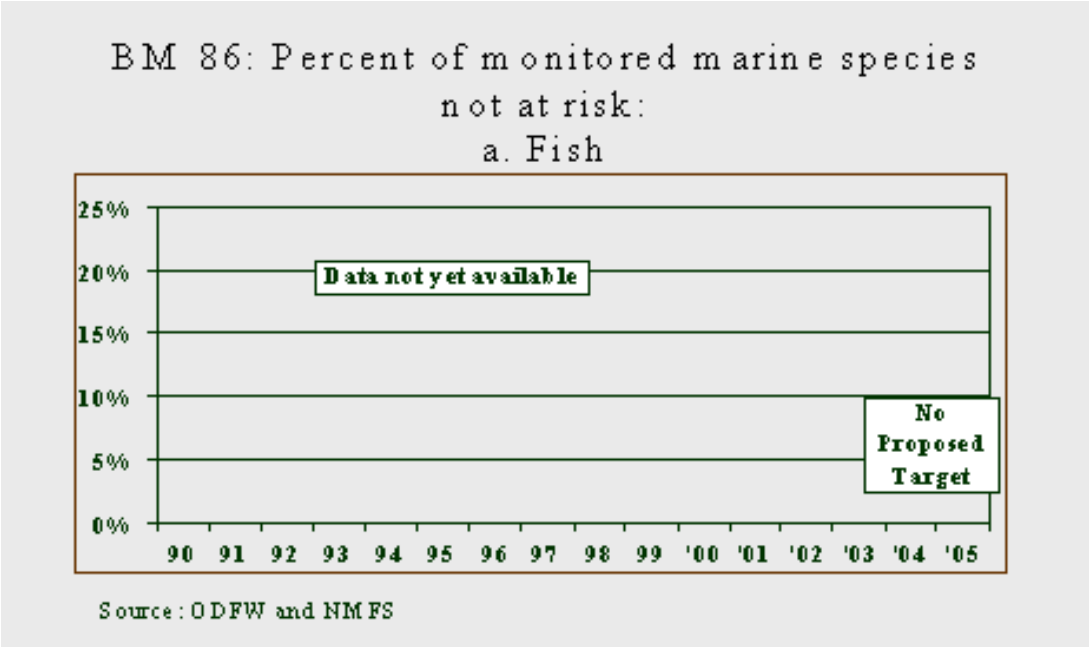
Issue: *How is the term "at-risk" defined for this Benchmark, and for Benchmarks 86 and 87?*

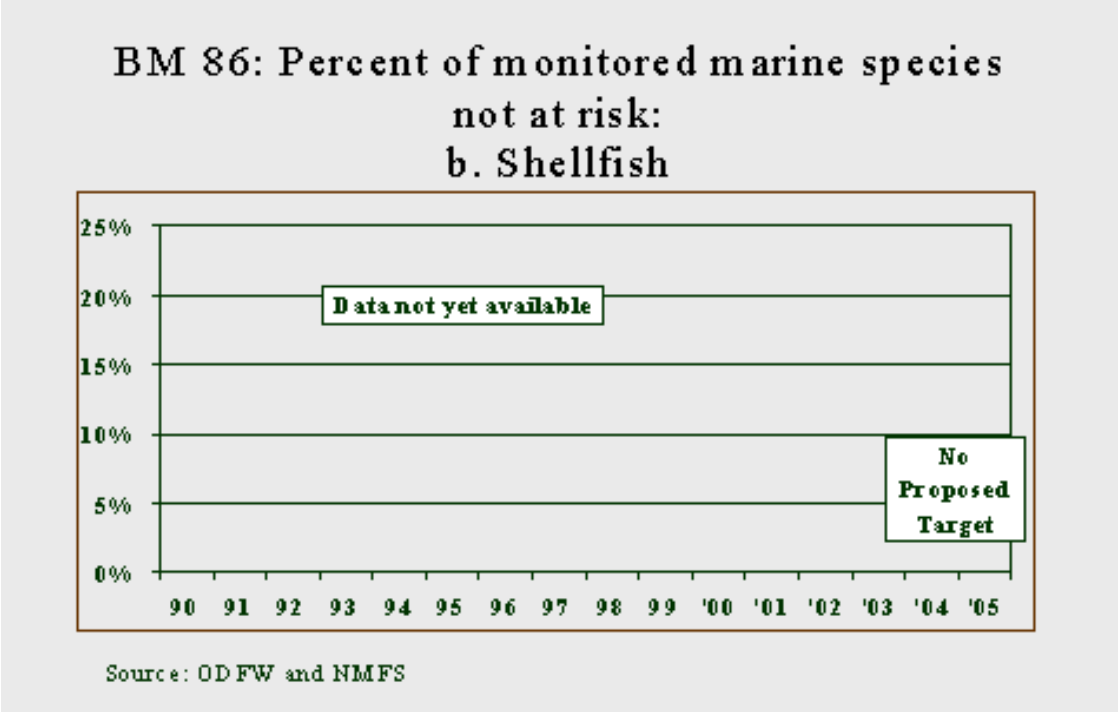
The term monitored is recommended to be substituted for "key" in the prior draft. The set of species for which we will have data is the set that is monitored. Key was too confusing.

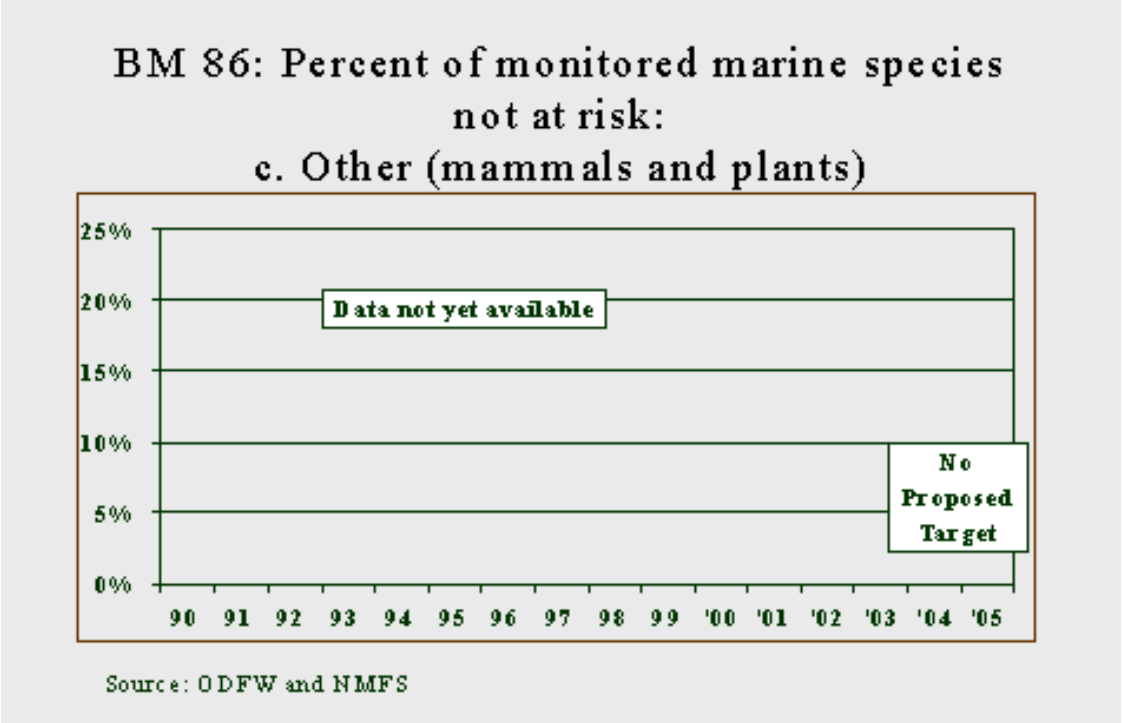
Currently, at-risk can be defined in a number of ways. To date, two definitions have been suggested for use in these Benchmarks, both with dramatically different results.

Recommendations of the Benchmarks work group
1. This Benchmark should be revised to be representative of statewide and ecoregion or basin scales.
2. Data for the revised Benchmark should be selected in consideration of data that are provided for other environmental indicators that may influence this Benchmark (e.g., water quality, stream flow, forest condition, exotic species).

Benchmark #86
***Current Language*: Percent of assessed marine species at risk.**
Proposed Language: Percent of monitored marine species not at risk
a) Fish
b) Shellfish
c) Other (mammals, plants)







* Evaluated nonsalmonid fish and shellfish species are those with landings of at least 1000 pounds/year for at least one year in the last ten and that have been evaluated through one or more of the following means: stock assessment, landings data, onboard observations, fishermen's logbook data, or other biological information; this includes 100 species for the reporting period. These 100 species comprise a significant portion of the total catch and are a good indicator of the overall health of the marine ecosystem.

** At-risk nonsalmonid fish and shellfish species include those that are either (1) designated by state or federal listing as over fished or at risk of being over fished; (2) listed as threatened or endangered under state or federal endangered species laws; or (3) are not currently producing or are unable to produce a directed take because of low population status. A species may be at risk due to natural

ecosystem variability, anthropogenic impacts (e.g., fishing), or some combination of the two.

Ecologically optimal value for sustainability = Note: Science working group stills needs to work on ecologically possible/optimal values for this Benchmark.

This value does not account for species that may be at risk almost entirely due to natural variability. No species are currently classified as such, but this could be an issue in the future.

Issue: *Does the definition of the Benchmark require any further clarification?*

Yes. The revised title for BM 86 partly clarifies the species that are included in this Benchmark. Further clarification is provided by the footnotes to the chart above.

Issue: *What is the current quantitative status of the Benchmark, and can or should that status be stratified by ecoregion, etc?*

Status of Data:
Current ODFW reporting is based on a combination of ODFW and National Marine Fisheries Service (NMFS) data on assessed and/or monitored stocks of nonsalmonid marine finfish and shellfish. Evaluated species are those with landings of at least 1000 pounds/year and that have been evaluated through one or more of the following means: stock assessment, landings data, onboard observations, fishermen's logbook data, or other biological information; this includes 100 species for the reporting period.

Earlier reporting by ODFW was based only on ground fish species for which there was a formal stock assessment (e.g., 22 in 2000). The status of the additional 78 species listed as "evaluated" in the new data above provides a more accurate representation of our knowledge base for exploited marine fish and shellfish and a more comprehensive evaluation of marine ecosystem health. Nevertheless, more robust stock assessments would be desirable to increase confidence in reporting.

Stratification:
None needed.

Issue: *Is there a documented status of the Benchmark at some point in the past that could be used as the historical reference? If so, what is the rationale for selecting this reference status and is it a useful comparison for setting a target now and in the future?*

Prior to commercial and recreational fishing, it must be assumed that no marine species were at risk, except those that might have been depressed by natural variability climatic or oceanic conditions. It is assumed that all species were sufficiently resilient to deal with natural variability, at least on human time scales.

Issue: *What is biologically and/or physically possible for the Benchmark's ecological conditions given existing limits, e.g., farms in what used to be forested valleys, Urban Growth Boundaries (UGBs), etc.? If such limits are not fixed, then how should the potential to alter those limits be addressed in*

the description of ecologically sustainable conditions?

If all fishing pressure were removed, then it is likely that all species populations currently at risk would rebuild to healthy levels, although this may take decades for some of the more long-lived species of rockfish. Although there are no actual data on the impacts of fishing on bottom habitat, removing fishing pressure would also allow any physical damage to habitat repair itself over time. However, this is only a theoretical discussion, since it is not likely that all fishing will be eliminated nor is it necessary. Such a change would have immense implications for one of the coast's more important economic activities and likely most important cultural heritage.

Issue: *What policies are in place to achieve the targets of the Benchmark? Are the policies adequate to achieve the targets?*

Principal Policies and Agencies:

International

International Pacific Halibut Commission

Federal

Magnuson-Stevens Fisheries Management and Conservation Act (1976 and as amended), regulations, Fisheries Management Plans; National Marine Fisheries Service; Pacific Fisheries Management Council (PFMC)
Sustainable Fisheries Act (1996) & regulations

State

State fisheries management statutes and administrative rules; Oregon Fish and Wildlife Commission; Marine Division, Oregon Department of Fish and Wildlife; Oregon Developmental Fisheries Board
Division of State Lands; statutes, administrative rules, and policy
Department of Land Conservation and Development/Oregon Coastal Management Program; Goal 19: Ocean Resources

Adequacy of policies:
The PFMC is currently addressing the inadequacies of their Ground fish Management Plan with respect to species designated as over fished or at risk of being over fished. PFMC and NMFS have needed authorities to protect and rebuild at-risk stocks. Resulting gear restrictions and trip limits may be having a positive impact on stocks. However, given the long-lived nature of many of the most depleted stocks, policy outcomes are not yet apparent.

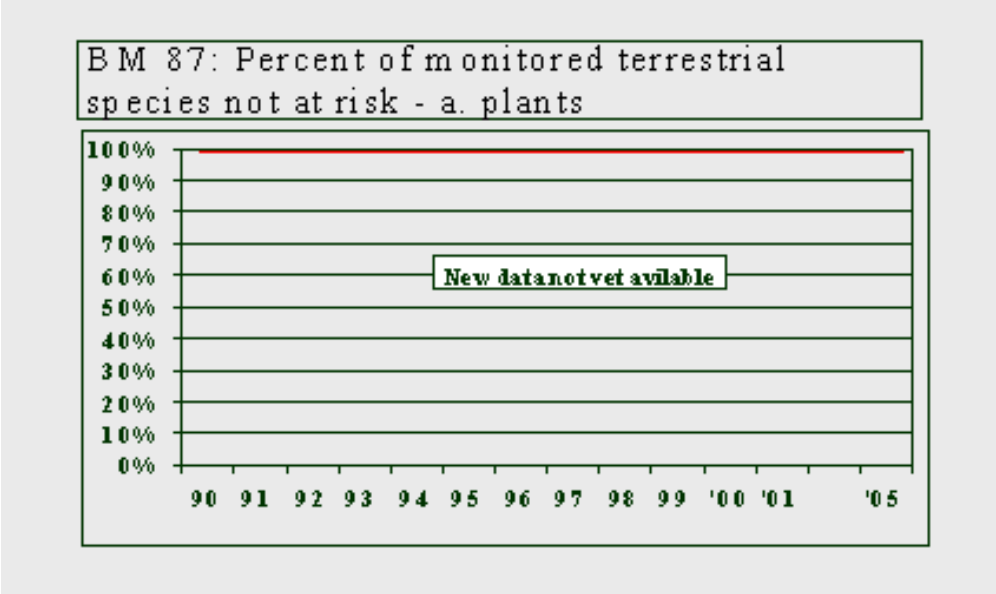
Oregon is currently addressing similar policy inadequacies for marine species management, but more needs to be done to fill data gaps and more actively monitor stocks. The state works closely with the PFMC, its technical and fishermen advisory committees, and policy-makers. Many management

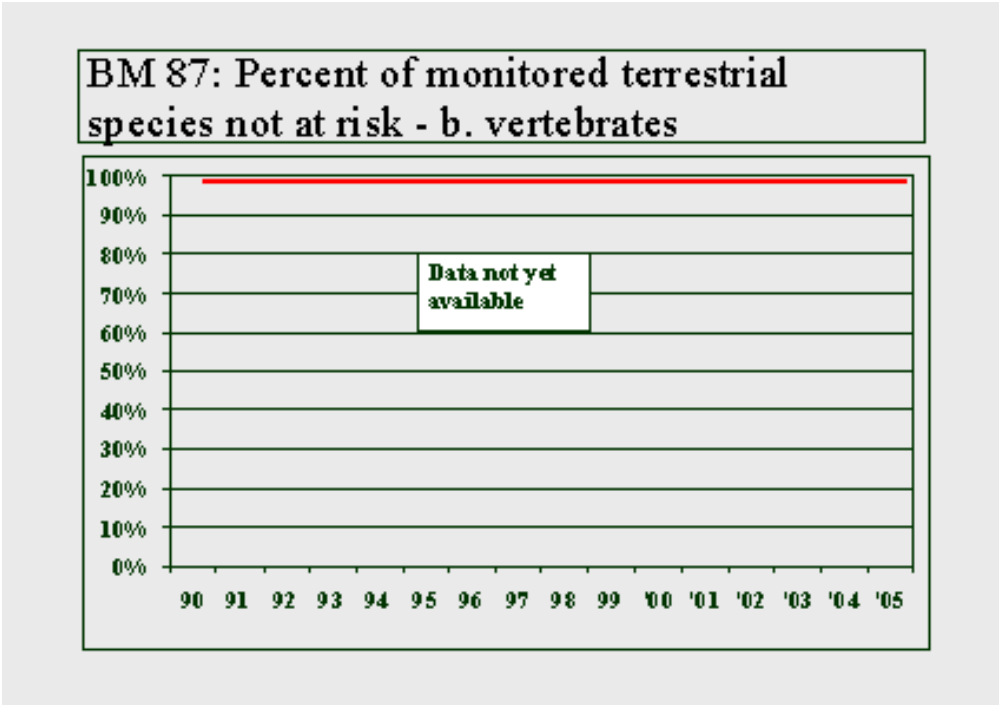
decisions are directly applicable and beneficial to Oregon's marine habitat and species health. Additionally, Oregon's Developmental Fisheries legislation and Board creates a biological and monitoring assessment mechanism for any new commercial fisheries in the state.

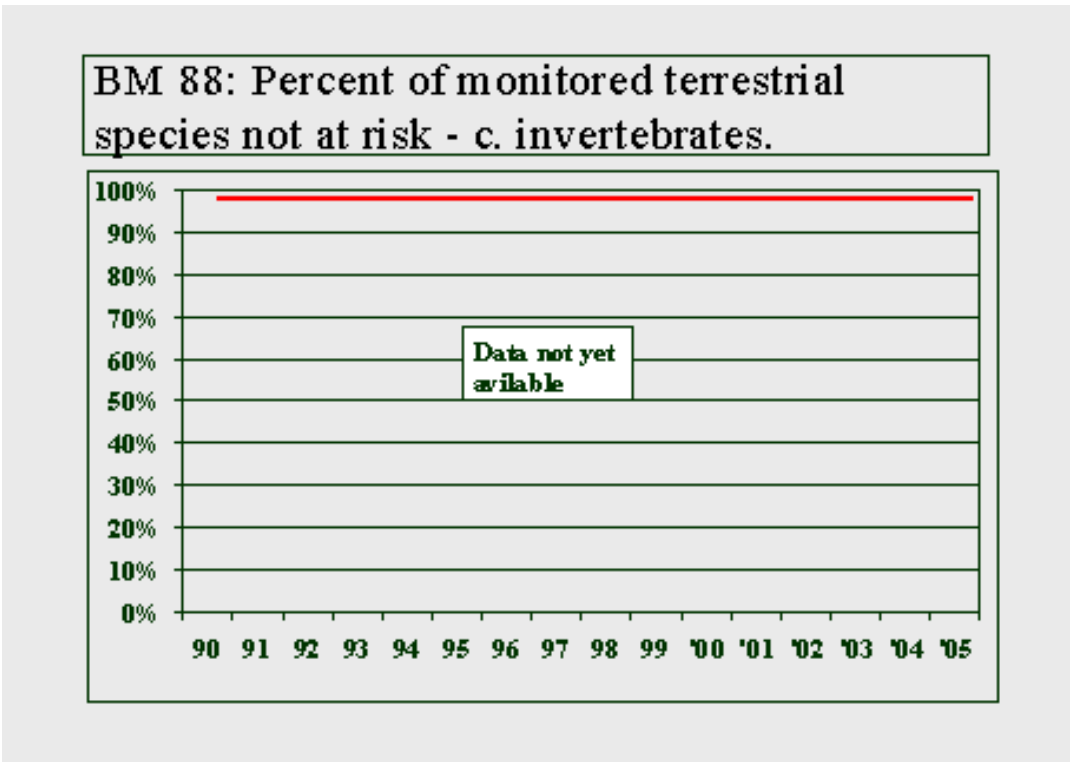
Benchmark # 87
***Current Language*: (Old #88) Percent of native animal and plant species that are not at risk.**
a. fish
b. animals
c. plants

***Proposed Language*: Percent of monitored terrestrial species not at risk**
a) Plants
b) Vertebrates
c) Invertebrates

Subject expert: Jimmy Kagan (Modified in accordance with July 3, 2002 workshop)







TK Hal - Somewhere along the line all of Jimmy's charts that are referenced here were dropped. Should they be in or not? Yes, refer to subject expert.

The following charts show the data in different ways, and show current trends for 2010. The chart below shows the number of at-risk species grouped by type and year.

This is the same data, for all groups each year. The data is shown for each group individually.

Native vascular plants (all taxa, including subspecies and varieties)

Native vertebrate wildlife (birds, mammals, reptiles and amphibians, all taxa, including var. and ssp.)

Native invertebrate species (mollusks, insects, worms, etc.)

Information from Spreadsheet (summarized)

Ecologically optimal value for sustainability = Note: Science working group stills needs to work on ecologically possible/optimal values for this Benchmark.

Issue: *Does the definition of the Benchmark require any further clarification?*

Yes. This Benchmark was originally supposed to be "The percentage of Oregon's native species that are healthy." Health is not directly measurable. Currently, data limitations make it impossible to identify how many native species we have in Oregon, especially for large taxonomic groups such as invertebrates, fungi, and lichens. Therefore, we have chosen to use vascular plants, wildlife and invertebrates as surrogates for all native species, since these are the taxa for which we have available data. The other limitation is in our ability, even for the well-known groups, to determine what species are "at risk." At-risk species are well defined, by law or statute, as being those taxa at-risk of extinction or extirpation from Oregon. This list is fairly well studied and reliable. However, there are a large number of vascular plants or wildlife species that may be declining, but are still too abundant to be considered at-risk, or are declining significantly in some regions of the state, but are healthy in other regions, or have simply not made it to the lists yet. As a result, there are no methods now for determining which species are actually healthy. Therefore, we have turned the Benchmark around, to look at the percentage of native plants, wildlife and freshwater fish that are not at-risk.

Issue: *What is the current quantitative status of the Benchmark, and can or should that status be stratified by ecoregion, etc?*

Information on the status of at-risk species is fairly good, maintained at the Oregon Natural Heritage Program. The data is based on the report *Rare, Threatened, and Endangered Plants and Animals of Oregon*, a document prepared by Oregon Natural Heritage Program, Oregon Department of Agriculture, Oregon Department of Fish and Wildlife, Division of State Lands, and Oregon Natural Heritage Advisory Council. The distribution of these species can be stratified by ecoregion or by watershed, and indeed the percentages are higher in more impacted ecoregions (such as the Willamette Valley), than less impacted ones (such as the Western Cascades).

Issue: *Is there a documented status of the Benchmark at some point in the past that could be used as the historical reference? If so, what is the rationale for selecting this reference status and is it a useful comparison for setting a target now and in the future?*

Historical data are available back to 1981.

Issue: *What is biologically and/or physically possible for the Benchmark's ecological conditions given existing limits, e.g., farms in what used to be forested valleys, Urban Growth Boundaries (UGBs), etc.? If such limits are not fixed, then how should the potential to alter those limits be addressed in*

the description of ecologically sustainable conditions?

The optimal value cannot be 100%, since some species are inherently rare, and some are extinct or extirpated. Based on the current number of very local, endemic species, approximately 2% of the taxa in the state will always be limited enough naturally that they will be considered to be at risk. A more careful analysis could identify the percentage (2%) to a decimal point (perhaps 2.5%), but this analysis is probably not useful at this time.

Issue: *What policies are in place to achieve the targets of the Benchmark? Are the policies adequate to achieve the targets?*

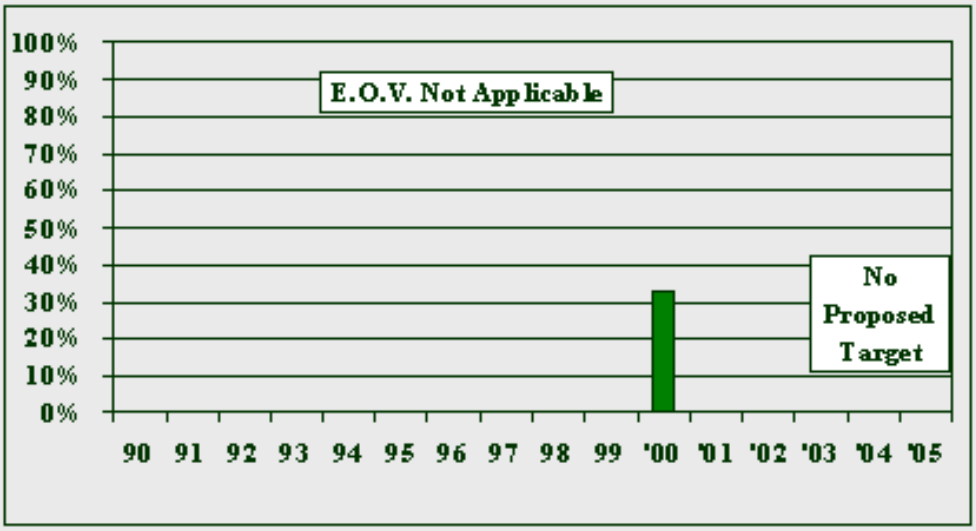
The main policies in place to directly achieve these targets are state and federal endangered species acts. These laws, if implemented, should be adequate to achieve the targets, with one possible exception. This is that plants occurring on private lands are exempted from take provisions of both the state and federal ESAs, making them more vulnerable. Implementation of these laws has caused major difficulties for the state and federal agencies responsible for them. Other laws and policies indirectly influence this Benchmark, e.g., Clean Water Act, Wilderness Acts, federal land policy acts.

Most other federal and state laws addressing land management deal with the requirements of the state and federal ESAs.

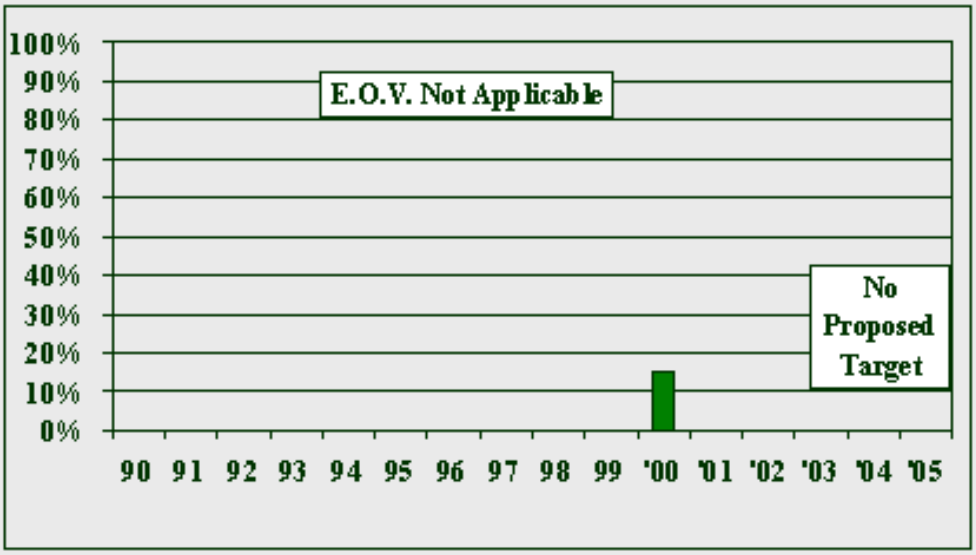
Benchmark #88
***Current Language*: (was #87) Percent of at-risk species populations that are protected in areas dedicated to conservation:**
a. species found in streams or rivers
b. other

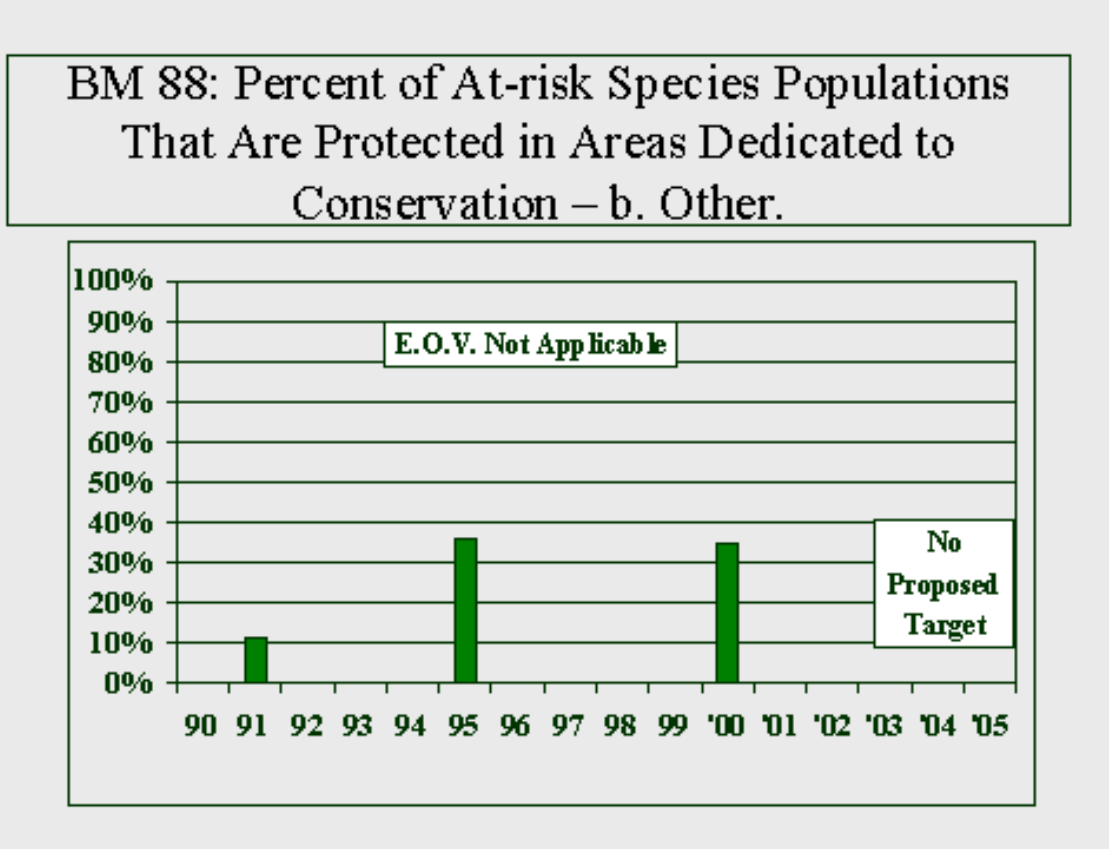
Subject expert: Jimmy Kagan(modified in accordance with July 3, 2002 workshop)
Need to change tables in line with new Benchmark

BM 88: Percent of At-risk Species Populations That Are Protected in Areas Dedicated to Conservation - Total.



BM 88: Percent of At-risk Species Populations That Are Protected in Areas Dedicated to Conservation – a. Species Found in Rivers and Streams.





We have Board approved targets for each of these for 2005 and 2010: 36% of all at-risk species populations in dedicated conservation areas by 2005; 38% by 2010. For streams, 20% of all at-risk species populations found in rivers and streams in dedicated conservation areas by 2005; 25% of river and stream at-risk species populations by 2010. For all other species, targets are 38% of at-risk species populations in dedicated conservation areas by 2005; 40% by 2010. These targets are policy targets and not ecologically possible or optimal values.

Explanation: This Benchmark measures the degree to which known occurrences or sites for at-risk species are protected in areas specifically dedicated to conservation. At-risk species include all plants and animals that are listed by the U.S. Fish and Wildlife Service, the Oregon Department of Fish and Wildlife, or the Oregon Department of Agriculture as threatened or endangered. They also include other species which are considered at-risk either by: 1) their inclusion as a candidate for listing by the agencies listed above, 2) being an ODFW sensitive critical or vulnerable species, or 3) if they are considered to be threatened or endangered by the Oregon Natural Heritage Program. The Benchmark tracks the percent of occurrences of these species that are found in dedicated protected areas. Dedicated protected areas include wilderness areas, parks and reserves, and areas managed for sustainable natural resource uses under classes I-VI in the International Union for the Conservation of Nature (IUCN) systems. Class VI, areas managed for sustainable natural resource uses could include all wildlands in Oregon in federal or state ownership plus those private lands zoned under Oregon land use laws for agriculture of forestry. This Benchmark, therefore, needs some policy clarification of what IUCN Class VI means in Oregon. Species, such as fish, which are found in rivers and streams, are measured in miles of protected streams. Birds, terrestrial mammals and plants are measured in either the area or number of their occurrences protected. This accounts for the two parts of the Benchmark.

Many risk species occur outside of areas that would qualify as IUCN protected areas, especially IUCN Classes I-V. Nevertheless, the land uses in and around their habitats may be conducive to their conservation. Thus, this Benchmark is not a truly comprehensive indicator of the degree of protection afforded to at risk species. Therefore, the team proposes a developmental Benchmark to replace the current Benchmark that would more directly inform on the actual status of at risk species.

Ecologically optimal value for sustainability - Does not apply

Issue: *Does the definition of the Benchmark require any further clarification?*

Yes. This Benchmark is currently a measure of a strategy, rather than the quality of the environment.

There is another way to define this measure, which is, **"the percentage of at-risk species populations which are either stable, increasing or not likely to disappear in the foreseeable future." This could alternatively be defined as "the percentage of at-risk species populations which are doing OK"**. This is a much better measure of environmental health. Currently, the Oregon Natural Heritage Information Center has a method to do this, by way of a field in the at-risk species population's database that describes the status of every occurrence. This field is currently populated for only about 20% of the occurrence records. Funds have become available to start to populate this field, but it will be at least 2-3 years before enough of the database is populated to provide a significant baseline.

This current Benchmark should be an interim measure to be used until the percentage of native habitats in the state can be measured - Developmental Benchmark 2024. The SOER panel recommended that a new measure, which is the percent of the state with native habitats, replace this measure - since native habitats are what support at-risk and all other species. Currently, there are no data available to allow us to measure this. The development of a high quality, land-use, land cover and vegetation map for the state, which could be updated every five to ten years, would provide the necessary data to measure the quality of the natural habitats. It would also be a better measure of how other state efforts to protect natural habitats and at risk species are working. The data would also assist in other areas of the environment, including acreage of forestlands lost or maintained, acreage of farmland lost or maintained, and the quality of rangelands.

Issue: *What is the current quantitative status of the Benchmark, and can or should that status be stratified by ecoregion, etc?*

Status of Data:

Currently, data for this Benchmark were obtained from the Oregon Natural Heritage Information Center. They include the GIS covers for at-risk species, which are updated constantly, and are reliable and fairly accurate. These at-risk species distribution covers are overlain over the managed area or protected area cover. This cover is also maintained at the Oregon Natural Heritage Program. The managed or protected area cover was developed as part of the Gap Analysis Program, and has some serious limitations. The data can be stratified by watershed or by ecoregion easily.

Data For Native Habitats (Land-Use Land Cover) (Developmental Benchmark # 2024):

Accurate land use - land cover information is not available. Current covers have ~ 20% error rate, which does not allow them to be used to measure the types of land use changes that are occurring. The current information has limited capacity to measure natural habitats. New technologies are available that would allow the state to develop this information, and it could possibly be applied to historic data to obtain trends. However, development of this information requires either a financial investment that the state is unable to make, or an incremental approach, which can only be done with a state agency or university lead.

Issue: *Is there a documented status of the Benchmark at some point in the past that could be used as the historical reference? If so, what is the rationale for selecting this reference status and is it a useful comparison for setting a target now and in the future?*

The date a protected area was established or dedicated is not included in the database. As a result, there are no historical patterns or trends to look at regarding this Benchmark. Updating this database and GIS cover to include the establishment date of all the sites, and updating the boundaries of some, is underway, and should be completed by the end of 2002. This being said, historical trends may not be all that useful, since the majority of designations have occurred in groups, as a result of federal or state legislation.

Issue: *What is biologically and/or physically possible for the Benchmark's ecological conditions given existing limits, e.g., farms in what used to be forested valleys, Urban Growth Boundaries (UGBs), etc.? If such limits are not fixed, then how should the potential to alter those limits be addressed in the description of ecologically sustainable conditions?*

It is biologically and physically possible to protect or designate 100% of the occurrences of at-risk species.

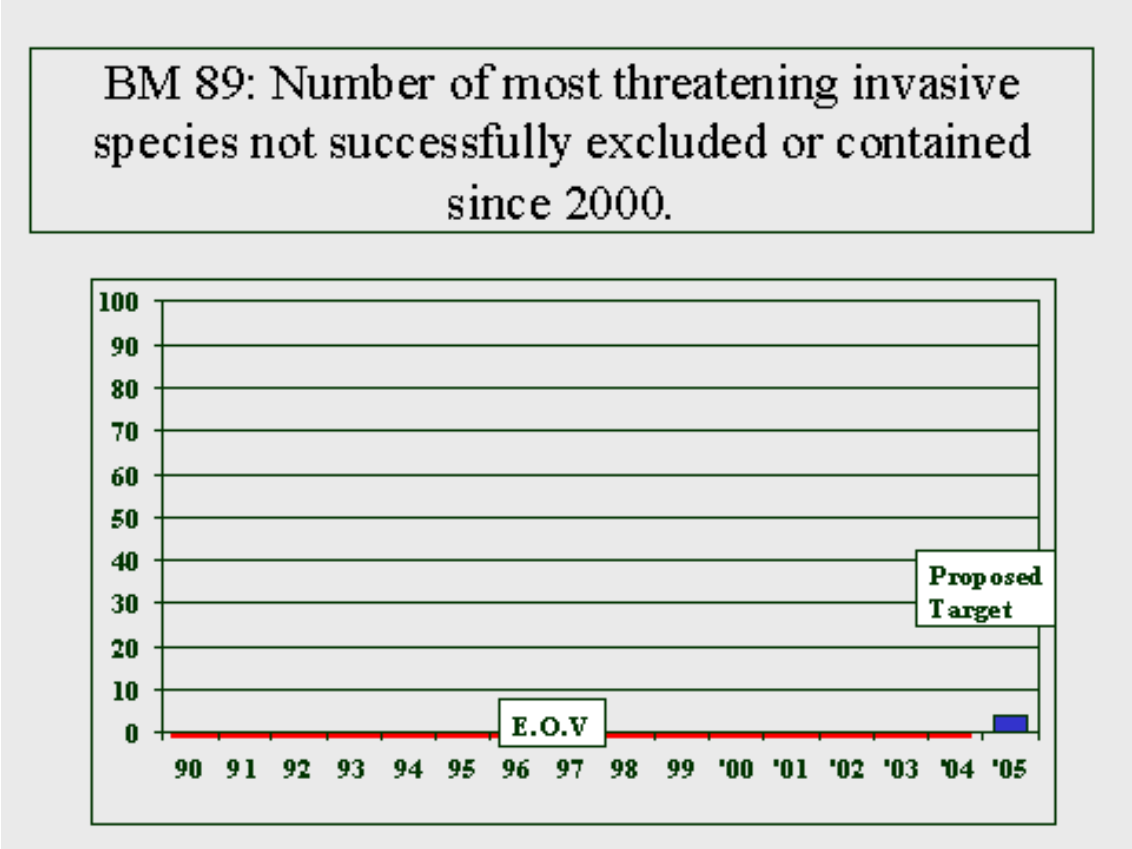
Issue: *What policies are in place to achieve the targets of the Benchmark? Are the policies adequate to achieve the targets?*

Federal policies related to the U.S. Endangered Species Act have had significant impact on achieving the targets of this Benchmark. State policies have been less effective, especially related to some at-risk fish. However, given that there are no ecological targets, the current policies, if implemented as they have been written, are adequate to achieve the targets.

Benchmark #89
***Pre-SOER language*: Number of nuisance invasive species established in Oregon**

***Current Language*: Number of most threatening invasive species not successfully excluded or contained since 2000.**

Subject expert: Dan Hilburn



Ecological Goal: 0

Suggested Target: Less than 1 per year.

Issue: *Does the definition of the Benchmark require any further clarification?*

No. The new Benchmark addresses problems that existed with the pre-SOER measure, including difficulty setting meaningful targets, defining an ecological goal, and assigning a reasonable grade for progress or lack there of.

The "Most Wanted" list approach addresses these problems. Oregon's newly created Invasive Species Council will come up with the list and keep score. Keeping undesirable invasive species out of the State is by far the best way to minimize their impacts. This new approach will measure how well Oregon does at protecting its environment from exotic nuisance species that threaten to invade the State. A focus on exclusion will highlight activities that have the greatest long-term benefits for the least cost.

Issue: *What is the current quantitative status of the Benchmark, and can or should that status be stratified by ecoregion, etc.?*

TK Can we update this outdated language? The list will be updated annually as new threats are identified.

Stratification may be desirable. One possible division that might be useful would be to indicate

whether a species is not known to occur in the State or whether it is established in a small area and being contained. Species could also be grouped into: marine, aquatic, and terrestrial and/or animal, plant, microorganism.

Issue: *Is there a documented status of the Benchmark at some point in the past that could be used as the historical reference? If so, what is the rationale for selecting this reference status and is it a useful comparison for setting a target now and in the future?*

For the worst exotic nuisance species, good information exists on whether or not they are established in Oregon. The recent effort by OSU, ODA, and other interested parties to develop a list of established nuisance species serves as a historical reference. The fact that something is "established" is a less important measure of "health" than the impacts that exotics are having. It seems like an index could be developed that could measure both the number of invasive species and the amount of land/aquatic area that has been invaded (invaded could be defined as when the exotic occupies more than 10 percent of a habitat or? However, this approach fails to capture the "big players" that can cause loss of native species, etc. This also doesn't capture the subtleties that may be critical measures of health. For example, rainbow trout have been stocked in many waters that historically may have been occupied only by cutthroat, or even cutthroat and rainbows, but the stocked strain is able to hybridize with the cutthroat. If "exotic" means something that only includes species not native to Oregon, as opposed to not native to the ecosystem, the results will be considerably different. (The author's personal opinion is that invasive species are a big deal and are becoming a bigger deal. So getting this Benchmark to truly reflect the health of the environment is important. However, the author does not know enough about the topic to be much help.)

Issue: *What is biologically and/or physically possible for the Benchmark's ecological conditions given existing limits, e.g., farms in what used to be forested valleys, Urban Growth Boundaries (UGBs), etc. If such limits are not fixed, then how should the potential to alter those limits be addressed in the description of ecologically sustainable conditions?*

Invasive species enter the state through several pathways. Many enter as contaminants of imported commodities (e.g., small broom rape, thistles) or hitchhike on vehicles, vessels, planes, etc. (Japanese beetle, European green crab). Still others are introduced intentionally (English Ivy, Scotch broom, nutria). The rate of introductions is following the same trend as the increase in global trade and travel. The question of what is biologically possible is influenced by limits on our ability to influence trade and travel patterns. Clearly we can't build a wall around the State, but it is also clear that we can improve our exclusion, detection and eradication efforts.

Though the ecologically optimal value would be zero, a more realistic target should be set to reflect trends in trade and travel and resource limitations.

Issue: *What policies are in place to achieve the targets of the Benchmark? Are the policies adequate to achieve the targets?*

Among the laws protecting Oregon from invasive species are the quarantine powers of the Department of Agriculture, the wildlife integrity rules of the Department of Fish & Wildlife, and the newly passed Ballast Water Management Act. Though not without flaws, these laws are strong and

give the state broad authority to deal with invasive species.

Unfortunately, enforcement is generally weak as are our detection and eradication capabilities. Resource and staff limitations are severe. Adequate survey programs exist only for a few of the most important exotic pests.

The creation of Oregon's new Invasive Species Council should help to address some of these shortcomings.

Table 1:
Summary of Findings

Summary and conclusions of Management Team, based on product of work groups.	**Current Benchmark Number**										
	77a	**77b**	**78**	**79**	**81**	**82**	**85**	**86**	**87**	**88**	**89**
Is current Benchmark is primarily administrative rather than ecological?	yes	yes	no	yes	no	y/n	no	no	yes	no	yes
Is methodology for calculating current Benchmark value clear?	yes	yes	yes	yes	yes	yes	no	yes	yes	yes	yes
Should current or revised Benchmark be stratified at ecoregion or basin scale?	yes	yes	yes	yes	yes	yes	yes	???	yes	yes	yes
Is ecological reference/optimum described for current or proposed Benchmark?	yes	no	no	no	yes	no	yes	yes	n/a	yes	yes
Is ecologically achievable value described for current or proposed Benchmark?	yes	no	no	no	yes	yes	no	no	n/a	no	no
Is current Benchmark judged to be a fair indicator of Oregon's environmental health?	no	no	yes	no	yes	yes	no	???	no	yes	no
Should current Benchmark be improved to be more informative of ecological health?	yes	yes	???	yes	yes	yes	yes	???	n/a	???	yes
Is potential wording for a more ecologically informative Benchmark proposed?	yes	yes	no	no	yes	yes	yes	yes	yes	yes	yes
Is there informative value in the Benchmark, either in its current or potentially revised form?	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes	yes
Is there significant potential to use remote sensing technology as a monitoring tool?	yes	yes	yes		yes						???
How frequently should the Benchmark be assessed (measured)?											

Is there likely a relationship between the value of this and other environmental Benchmarks?			79 85	78 85			77a 77b 78 79 81 88 89	77b		85 89	85 88

Ask Jay what the shading means.

Table 2:
Comparison of Oregon and Selected National Indicator Categories

Indicator Category	Oregon Benchmarks	SOER 2000	National Research Council 2000	Hienz Center 2002
Air Quality	X	X		
CO2 Emissions	X	X		
Wetland Preservation	X	X	Land use/Land cover	
Water Quality	X	X		
Water Quantity	X	X		
Ag Land Preservation	X	X	Land use/Land cover	
Forest Land Preservation	X	X	Land use/Land cover	
Timber Harvest	X	X		
Solid Waste	X			
Hazardous Waste	X			
Freshwater Species	X	X		At risk native species
Marine Species	X	X		At risk native species
Terrestrial Species	X	X		At risk native species
Species in Conservation Areas	X	X		
Invasive Species	X	X		

State Parkland Area	X	X		Outdoor recreation
Riparian Condition		X	Land use/Land cover	
Aquatic Index		X		
Soil and Erosion		X	Nutrient runoff/Soil organic matter	
Groundwater		X		
Total species diversity			X	
Native species diversity			X	
Carbon storage			X	
Production capacity			X	
Net primary productivity			X	
Lake trophic status			X	
Stream oxygen			X	
Ecosystem extent				X
Fragmentation and landscape pattern				X
Nutrients, carbon, oxygen				X
Chemical contaminants				X
Physical conditions				X
Plants and animals				X
Biological communities				X
Ecological productivity				X
Food, fiber, and water				X
Other services, including recreation				X

Notes from the Progress Board Fish Benchmark Summit, July 3, 2002 1:00-4:00 pm

(Including comments from Jimmy Kagan who did not attend.)

Attendees: See Appendix 1

Hal Salwasser challenged the individuals at the meeting to come up with indicators that are understandable with replicable and quantifiable data that are the result of clear and objective calculations. The current data used by the Progress Board for salmonid health is not replicable and the methodology is not well documented. The Benchmarks on fish need to be clearly defined so that the average Oregonian can understand them.

Dave McAllister commented that often times an objective evaluation would be used to monitor the population changes. However, Jeff Tryens pointed out that if there was a list of agreed upon criteria then it would not matter who was doing the calculations. Lindsay Ball said there is good hard information available, but it may not be as scientific or academic as some people want it to be.

Jay Nicholas proposed the wording for a new Benchmark. Percent of salmon and steelhead Evolutionary Significant Units (ESUs) not at risk. It would mean a transition from population to ESUs and from healthy to not at risk using the Endangered Species Act to define risk. ESUs have been defined for most salmon and steelhead populations. If the ESU is not on the State's List then it's not at risk. While using ESUs may not be the complete answer, establishing one indicator at a higher level will encourage the state to look at things more carefully. Plus, ODFW already measures ESUs. However, it doesn't quite give you basin level data since the information is lumped together. Another problem with ESUs is that they are defined politically and are a constant game of catch up. ESUs are defined after the fact and it might be best to measure something more biologically independent.

A species would be called at risk, if it were on a federal list or state list. (from Jimmy Kagan: WHAT FEDERAL OR STATE LIST? ODFW Sensitive Species List? If so, this is fine. If the list is the list of taxa designated by the state or the federal government as Threatened and Endangered Under the State or Federal ESAs, this is not reasonable. The current list of T&E species has been established largely as a result of political pressure and lawsuits, rather than any type of scientific objectivity. The use of the NatureServe Ranking, which is currently being used for other biodiversity Benchmarks, is clearly preferable. If NatureServe Ranking were to be used, the summit would need to evaluate how to define at-risk. Currently, the Oregon Natural Heritage Information Center of the Natural Resources Institute defines at-risk as species ranked G1 or G2 (Globally critically endangered or globally endangered, PLUS those ranked S1 (Critically endangered in Oregon but perhaps more common elsewhere), PLUS those species LISTED as threatened or endangered by the State or Federal ESA. This is a larger list, but does a much better job indicating the actual status of fish, wildlife or plant biodiversity in the state. While the group agreed that defining at risk by the federal and state lists implies that species not on the list are healthy which is not always the case. However, with limited resources the focus needs to go on the species we could lose for good.)

Ian Fleming suggested that random block sampling could give a good overall picture. The blocks would be the lowest level of statistical significance and would be a smaller area than basins. Block data is not yet available statewide, but that is the goal.

The discussion then focused on what unit of measurement to use. All agreed it needed to be something people value, ESUs give us a place to start. They are both definable and replicable. While populations are important biologically, they are not relevant to policy, plus populations can differ dramatically in size and importance Jeff Tryens felt that ESUs were not well understood by most people. The group agreed that species was a more easily understood term that was almost as good

as ESU. Since it encompasses ESUs, the relationship will be explained in the endnote to any Benchmark report.

Many members of the group expressed concern that the marine eco-system was too complicated to lump it into one Benchmark. A single measure will not serve as a warning when things are going bad.

Dave McAllister suggested that if we are going to track invertebrates, we are going to need a master list, possibly geographic specific. To include a lot of species without assessing the measure would not be meaningful. Adding the word key or monitored to the Benchmark wording will be important. Key is the preferred wording. While key was not defined during the meeting, it will need to be in the future. Key is vague, but it means the species is important. (From Jimmy Kagan: I believe the work KEY is meaningless, not vague. If the measure is the percent of species considered to be "at-risk", it is only meaningful if it refers to the percentage of "all species". The reality for many groups, particularly marine fish and invertebrates, there is no known value for how many species there are. There are two solutions for this. The simplest is for groups of taxa for which there are no known, verifiable estimates of how many species there are, we (INR) should evaluate the available data, and come up with one of two numbers. The most academically pleasing number would be the number of taxa in the group "known". This is currently the understanding related to taxa such as birds, mammals and vascular plants. Clearly we may yet find unknown species of vascular plants in Oregon, but this will not likely change the percentage of at-risk species significantly. If we use this number for invertebrates, marine fish, and non-vascular plants, it is likely that additional species will be discovered as fast as species are added to the list of at-risk species, which might make the percentage of at-risk species appear lower than it really is. The other alternative is to have the "experts" in the group make their best guess as a baseline number for the group in Oregon. While to get the "experts" to do this will be a bit like pulling teeth, I believe that it is possible, and that the number will give the public the best view of how well we are doing on this Benchmark. Of secondary note, the for invertebrates and non-vascular plants, the state has NO authority to list taxa under the ESA, and there are only 3 listed invertebrates, and no listed non-vascular plants or fungi, in spite of the fact that many of these taxa are clearly at-risk, which is another argument for using the NatureServe ranks to define at-risk.)

The group agreed that invertebrates should be listed in the Board's 2003 Benchmark Performance Report, but with no data.

The group unanimously agreed to recommend the following revisions to the current Benchmarks relating to plants and animals:

85. Percent of monitored freshwater species not at risk

- a. Salmonids
- b. Other fish
- c. Other Organisms (amphibians, mollusks, etc)

86. Percent of monitored marine species not at risk

- a. Fish

b. Shellfish
c. Other (mammals, plants)

87. Percent of monitored terrestrial species not at risk:

a. Plants
b. Vertebrates
c. Invertebrates (clarify, will not track them all)

88. Percent of at-risk species populations that are protected in areas dedicated to conservation.

a. Species found in rivers and streams
b. Other

Developmental Benchmark options: 1) Percent of at risk species with conservation plans, 2) percent of at risk species meeting conservation plan goals, or 3) percent of at-risk species populations which are increasing or stable.

Other ways to track at risk species were suggested. One was to do a trend analysis by calculating the change in number of species not at risk. Also, we could use state rankings to see how Oregon is doing compared to other states. Jeff said that since the Board will probably consider these Benchmarks "key", this other information would be included in the analysis of those Benchmarks.

Notes compiled by Katie DeWilde, Oregon Progress Board, (503) 986-0035.

Appendix 1

Participants

Hal Salwasser (co-chair): Dean College of Forestry, Director Oregon Forest Research Laboratory, Acting Director Institute for Natural Resources, Oregon State University. Subject Expert: Forest ecosystem management and conservation, wildlife ecology, and natural resources policy.

Logan Norris (co-chair): Professor emeritus, Oregon State University. Subject expert: forests, fish

Jay Nicholas (co-chair): Senior Science and Policy Advisor, Oregon Watershed Enhancement Board. Subject Expert: Salmonid ecosystem management and conservation, salmonid ecology.

Gary Ball: Manager, Hydrographics / Measurement & Reporting Section, Technical Services Division, Oregon Water Resources Department. Subject expert: water rights and water measurement.

Kevin Birch: Planning Coordinator, Forest Resource Policy Division, and Oregon Department of Forestry. Subject Expert: Forest management. Currently assigned to help the Department and Board of Forestry use indicators to set objective based policy goals and measure progress toward their

achievement. Recently completed work as coordinator of Oregon's First Approximation Report on the Criteria and Indicators of Forest Sustainability from the Montreal Process.

Debbie Colbert: Water Policy Analyst, Director's Office, Oregon Water Resources Department. Subject expert: State water policy.

Richard Dick: Professor of Soil Science, Oregon State University, research interest soil ecology.

Jim Good: Extension Specialist, College of Oceanic and Atmospheric Science, Oregon State University. Subject Expertise: coastal resources

Stan Gregory: Professor, Department of Fisheries and Wildlife, Oregon State University. Subject expert: fish.

Rick Hafele: TK title

Dan Hilburn: Administrator, Plant Division, and Oregon Department of Agriculture. Chair, Oregon Invasive Species Council. Subject Expert: Invasive species, regulatory entomology.

Norm Johnson: Professor, Department of Forest Resources, Oregon State University. Subject expert: forests.

Jimmy Kagan: Director, Oregon Natural Heritage Information Center, Institute for Natural Resources, Oregon State University. Subject Expert: Oregon Flora, Oregon Vegetation, Conservation Biology, Oregon biodiversity.

Janet Morlan: Wetlands Program Manager, Oregon Division of State Lands. Subject Expertise: Wetland management and regulation; wetland restoration; natural resource land use planning.

David Morman: Director of the Forest Resources Planning Program, Oregon Department of Forestry. Subject Expert: Forest management, sustainable forestry criteria and indicators, strategic forest and natural resource policy planning.

Gordon Reeves: Research Fish Biologist, USDA Forest Service, Subject Expertise: fish, rivers

Mark Systma: TK title

July 3, 2002 Workshop

Hal Salwasser: see above

Jay Nicholas: see above

Lindsay Ball: Director, Oregon Department of Fish and Wildlife

Roy Elicker: Deputy Director, Oregon Department of Fish and Wildlife

Bruce MacIntosh: Oregon Department of Fish and Wildlife. Subject expert: fish

Steve Williams: Oregon Department of Fish and Wildlife. Subject expert:

Dave McAllister: Oregon Department of Fish and Wildlife. Subject expert: habitats

Ian Fleming: College of Ocean and Atmospheric Science, Hatfield Marine Science Center, Oregon State University. Subject expert: salmonid fish

Michael Banks: College of Ocean and Atmospheric Science, Hatfield Marine Science Center, Oregon State University. Subject expert: salmonid fish

Kelly Moore: Oregon Watershed Enhancement Board. Subject expert: fish, monitoring

Doug Markle: Professor, Department of Fisheries and Wildlife, Oregon State University. Subject expert: fish.

Ron Risser: Oregon Department of Transportation. Subject expert:

Jeffrey Tryens: Executive Director Oregon Progress Board. Subject expert: Benchmarks

Katie DeWilde: Intern Oregon Progress Board. Subject expert: minutes and records

Appendix 2

A Brief History of the Oregon Progress Board

The Oregon Legislature created the Oregon Progress Board in 1989, to be the steward of the state's strategic plan, ***Oregon Shines***. Chaired by the Governor, the Board is composed of community and business leaders and public officials.

Since its creation, the Progress Board has provided a forum to help Oregonians shape their preferred future. In 1991, the Board issued a set of indicators, called Oregon Benchmarks, to help policy makers and Oregonians track how well the state is doing in achieving the Oregon Shines' vision.

Over the years, the Oregon Shines' vision and the Benchmarks have been influential in statutory reforms of K-12 education, industrial development, public assistance, and workforce development and services to children and families. The legislature also requires state agencies to develop performance measures that are designed to influence Benchmark trends.

In 2000, the Board published the first-ever systematic, scientific assessment of Oregon's environment - *State of the Environment Report 2000*. The Board also issues reports on:

- Progress toward achieving Benchmark targets,
- Benchmark data at the county level; and
- Demographic trends affecting Oregonians.

With support from over a dozen other state agencies, the Progress Board administers a 4,000 household phone survey that provides data for over a dozen Benchmarks and a host of other issues of concern to state government.

Staff travels regularly to meetings across Oregon to present information on statewide and county trends. Progress Board data is widely used at both the state and local level by public officials, community leaders, and charitable organizations.

Appendix 3

Key Definitions and Assumptions

At Risk Species: Species whose amounts (i.e., numbers), qualities (i.e., demographics), distribution, and/or vulnerabilities to human activities (i.e., toxic chemicals) are such that they have been listed as an endangered or threatened species by the responsible state or federal agency (or ranked as being at peril by the NatureServe global ranking system - this is currently under discussion as a developmental Benchmark modification for the future).

Benchmark: A standard of measurement or evaluation; a reference point for comparison of change

Criteria for Indicators (from National Research Council 2000: "Ecological indicators for the nation"):

- General importance: it provides information about major changes that affect wide areas
- Conceptual basis: it is based on well understood and generally accepted knowledge about the system in question
- Reliability: it has a track record of working as intended, with acceptable flaws (nothing will be a perfect, infallible indicator)
- Temporal and spatial scales: it is appropriate to the scale of intended application
- Statistical properties: its accuracy, sensitivity, and precision are sufficient to show change in a clear way
- Data requirements: the kinds and amounts of data needed to characterize the indicator are feasible
- Skills required: the technical and conceptual skills of people who measure or describe the indicator fit institutional capacities
- Data quality: documentation of sampling and analytical methods assure known accuracy and consistency of data that inform the indicator
- Data archiving: an archiving system exists to keep the data current and available for trend analysis
- Robustness: the ability to yield reliable and useful information in the face of normal perturbations
- International compatibility: compatibility with indicators used in other systems, especially in

national systems
- Costs, benefits, cost-effectiveness: values and costs of tracking the indicator are in balance

Criterion: A standard on which judgment is based (dictionary).

Ecological Optimum-Reference (this could also be stated as the Ecological Reference Range of Conditions): We must make the assumption that conditions for the Benchmark, i.e., amounts, qualities, and/or distributions, are/were optimum at some reference point in time. Specifically, we assume that point in time to be prior to major transformations of Oregon's lands and waters that accompanied settlement and development by non-Indian settlers in the mid 19th century. This assumption does not imply that the conditions of lands, waters and biota at this reference time were unaffected by human actions. Indeed, these conditions were most likely the results of combinations of resource uses, human activities, e.g., use of fire, and various natural events such as volcanoes, floods, fires, and droughts. Nor does this assumption of optima at a reference time imply a single, static condition for the Benchmarks. Nature, even when unaffected by human activities, is variable over time and space and the optimal conditions would have existing within a range of variation caused by natural and human forces.

Ecologically Possible: Amounts, qualities, and/or distribution of the Benchmark that are biologically and physically possible given natural variability, prevailing human uses, e.g., harvests and prevailing human interventions such as the use of technologies to maintain productivity or restoration, and existing infrastructure that is not likely to decline in the future, e.g., highways, dams, metropolitan areas. Achieving these Benchmark conditions might require politically and economically feasible alterations in human uses and interventions. We do not assume that politically or economically infeasible alterations such as relocating a major metropolitan area, removing the Interstate Highway System or breaching major dams on the Columbia River, are possible.

Ecologically Sustainable: The amounts, qualities, and/or distribution of the Benchmark are such that given natural variability and prevailing human uses, e.g., harvests and interventions such as the use of technologies to maintain productivity or restoration, there is, in the opinion of pertinent scientific experts, a 95% or better likelihood that the Benchmark at these conditions and with these uses and interventions is ecologically sustainable for an indefinite period into the future. This also assumes that ongoing improvements in our knowledge and technologies will continuously alter our understandings of what will be required to maintain ecological sustainability. For many Benchmarks, current human uses and interventions exceed those of the reference time, e.g., dams on main-stem rivers, thus also requiring human interventions to maintain Benchmark sustainability. A Benchmark trending in a negative direction would not pass this criterion for sustainability. Reversal of negative direction could entail alterations in human uses and/or interventions. Natural variability will cause annual fluctuations that are not correctable by normal human interventions.

Indicator: Repeated observations of natural and social phenomena that represent systematic feedback;
quantitative measures of the economy, human well-being, and impacts of human activities on the natural world; information on progress in navigating the transition to sustainability (National Research Council 1999)

Healthy Populations/Ecosystems: Populations or Ecosystems whose biological and physical characteristics, i.e., amounts, qualities, and/or distributions, are sufficient to sustain their desired qualities, goods and/or services. An agricultural ecosystem, marine fisheries, or tree farm is healthy if it meets federal and state environmental standards and sustains expected human uses along with its ecological resilience and productivity over time. A wilderness area, natural forest or wildlife management area is healthy if it sustains the qualities and characteristics for which it was designated, i.e., a wilderness area that shows visible signs of human interventions or non-native invasive species would not be functioning as a healthy wilderness area, a native fisheries that requires annual stocking of hatchery fish is not a healthy native fisheries, and a natural forest vulnerable to uncharacteristic wildfires or invasive plants would not be functioning as a healthy natural forest. At landscape and regional geographic scales, ecosystem health is likely to include conditions of human communities and economies.

Policy Perspectives on Indicators (from National Research Council 2000: "Ecological indicators for the nation") they must be:

- Understandable by the range of people who will be using them
- Quantifiable
- Broadly applicable
- Based on clear and objective calculations (i.e., not an aggregation of subjective findings by various people)